

Study of carpal tunnel syndrome in diabetic polyneuropathy with comparison of inching method and second lumbrical-interossei test

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Keywords

Carpal Tunnel Syndrome; Diabetic Neuropathies; Electrodiagnosis; Nerve Conduction

Abstract

Background: Since diabetic generalized neuropathy affects peripheral nerves, the diagnosis of carpal tunnel syndrome (CTS) with conventional electrodiagnostic techniques (EDX) [onset latency of median sensory nerve action potential (SNAP) or distal latency of median compound muscle action potential (CMAP)] is controversial. The aim of this study is to investigate the diagnostic values of two other techniques including inching method and second lumbrical-interossei test in patients with diabetic polyneuropathy (DPN) as well as signs or symptoms of CTS.

Methods: Fifteen patients (30 hands) with definite diagnosis of generalized peripheral neuropathy secondary to diabetes who developed signs and symptoms of CTS were participated. For diagnosis of CTS, sensory and motor median distal latencies were considered by nerve conduction study. In the next step, inching method and second lumbrical-interossei test were performed for all hands. Finally, sensitivity

and specificity of two tests were calculated.

Results: Mean age of participants was 53.87 ± 11.53 years. The sensitivity and specificity of inching method in this study were 95.65% and 85.71%, respectively, and for the second lumbrical-interossei test, they were 73.91% and 71.42%, respectively.

Conclusion: Inching method was more sensitive and specific than second lumbrical-interossei test in diagnosis of CTS among patients with diabetic peripheral neuropathy. Moreover, the sensitivity of inching method was greater than specificity.

Introduction

Diabetes mellitus (DM) is the most common metabolic disease worldwide. Several forms of peripheral neuropathies are concomitant with DM, but the most common type is distal symmetric sensory polyneuropathy (DSPN).¹

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Moreover, carpal tunnel syndrome (CTS) happens frequently in patients with DM.² It is the result of the compression of the median nerve via the nonflexible carpal tunnel, where increased pressure, ischemia, and inflammation induce segmental demyelination and finally, secondary axonal damage.³ This syndrome usually causes sensory changes in the radial 3.5 digits of the hand and a subjective sensation of swelling.⁴ Clinical CTS can be confirmed by electrodiagnostic techniques (EDX) that document abnormalities of the median nerve fibers.⁵⁻⁷ It is the gold standard test for diagnosis of CTS, grading of the severity of damage, evaluating the effect of treatment, and ruling out the differential diagnosis such as radiculopathy and brachial plexopathy.⁸ Sensory nerve conduction study is mostly sensitive for abnormal findings in CTS and DSPN as well.^{1,9} Because many attributes can be chosen in nerve conduction study for confirmation of DSPN, diagnostic criteria may be different and no formal consensus exists.¹⁰ Inching technique is a method that stimulates median nerve sensory fibers in 1-cm interval across the wrist and into the hand while recording from the second or third digit (short segment stimulation).¹¹ It can localize an area of nerve with focal slowing, thus suggesting a relationship between an anatomic site of neural deficit and an electrophysiologic conduction abnormality. The normal latency difference between adjacent stimulation points is between 0.16 and 0.21 milliseconds (ms). Short-segment latency beyond these limits may be abnormal and shows focal slowing of neural conduction. This technique differentiates the CTS from a more distal involvement, for example in patients with diabetic polyneuropathy (DPN).¹² The best method to differentiate the peripheral neuropathy from CTS is the second lumbrical-interossei test. In this method, the interlatency difference between median nerve to second lumbrical and ulnar nerve to second interossei more than 0.4 ms is abnormal.¹³⁻¹⁵ Since DPN affects peripheral nerves, the diagnosis of CTS with conventional EDX [onset latency of median sensory nerve action potential (SNAP) or distal latency of median compound muscle action potential (CMAP)] is controversial. Thus, the aim of this study is to consider diagnostic values of two better techniques including inching method and second lumbrical-interossei test in patients with DPN and CTS with confirmed diagnosis through conventional EDX. Sensitivity and specificity of these two methods were

calculated and compared to each other to determine the better diagnostic technique for CTS in such patients.

Materials and Methods

Study design: This was a cross-sectional study. Patients with age in the range of 26-70 years, history of DM with confirmed peripheral neuropathy as well as presentation of pain, paresthesia, and numbness in a median nerve territory, awakening at nights, history of falling things from the hands, and positive median sensory tests such as nerve compression or Phalen's tests or Tinel's signs who referred to our electrodiagnosis clinic were included. In contrast, patients with brachial plexus injury, history of cervical radiculopathy, wrist or hand surgery, hereditary peripheral neuropathy or other peripheral neuropathy, steroid injection in wrist within 3 months ago, thyroid dysfunction, cancer and chemotherapy, collagen vascular disorders, uremia, drug consumption that caused neuropathy, and history of trauma, fracture, and deformity of upper limb were excluded. Based on data from similar studies, volume of sample was equivalent to 30 hands (15 patients). The skin surface temperature was maintained above 32 °C during the conduction studies. The tests were done by a Medelec Synergy electromyography instrument (Viasys Healthcare UK, Manor Way, Old Woking, Surrey, UK). Written type of informed consent was taken from each patient. The protocol was approved by the Ethics Committee of Shiraz University of Medical Sciences, Shiraz, Iran, with code number of "ir.sums.med.rec.1396.32". In the first step, history taking and physical examination for all patients was performed in EDX clinic. A conventional nerve conduction study of four limbs was done for approving peripheral neuropathy. Then, for considering CTS, distal median motor latency was taken from abductor pollicis brevis (APB) muscle by stimulation of the median nerve at wrist from 8 cm proximal to the recording site. Furthermore, stimulating of the median nerve 7 cm and 14 cm proximal to the active recording electrode from midpalm and wrist crease was performed, respectively, for detection of antidromic sensory latency from the third digit. The forearm, wrist, and hand were fixed on a comfortable board. Diagnostic criteria for confirmation of CTS included distal median sensory latency more than 3.6 ms and/or distal median motor latency more than 4.2 ms. After their

initial routine EDX study, we performed inching test for median sensory nerve fibers antidromically. We recorded from third digit and stimulated through wrist at 8-points. The distal wrist crease was considered as the zero point while 3 points proximal and 4 points distal to it were the other stimulation sites which were marked with 1 cm intervals. For second lumbrical-interossei test, the recording active electrode (E1) was placed at the midpalm over the third metacarpal bone, whereas the reference electrode (E2) was attached to the palmar digital crease area. Finally, median and ulnar nerves were stimulated at wrist at 8 cm proximal to E1 individually.

The sensitivity of inching method and second lumbrical-interossei test was calculated as: (number of CTS hands with our test/number of CTS hands with conventional EDX) \times 100. The specificity was calculated as: (number of hands with no CTS in our test/number of hands with no CTS in conventional CTS) \times 100. All analyses were carried out using SPSS software (version 16, SPSS Inc., Chicago, IL, USA).

Results

Age and sex: Thirty hands with usual symptoms and signs of CTS as well as history of DM with confirmed peripheral neuropathy by conventional EDX were participated. Mean age of the patients was 53.87 ± 11.53 years (range between 26-70 years). Ten participants were women, while 5 patients were men.

Comparison of sensitivity between two tests: In our study, thirty hands with diagnosis of diabetic peripheral neuropathy were included. Twenty-three hands were detected as CTS with conventional EDX; out of this number, inching method was positive in 22 hands. Inching test was positive if distal latency difference of two points behind each other was greater than 0.21 ms. The sensitivity of inching test was calculated: $22/23 \times 100 = 95.65$. Out of 23 hands with CTS, 17 hands were positive with 2nd lumbrical-interossei test. This test was considered positive if distal motor latency difference of median and ulnar nerves was greater than 0.4 ms. The sensitivity of this test was calculated: $17/23 \times 100 = 73.91$. Therefore, according to this study, inching method was more sensitive than second lumbrical-interossei test.

Comparison of specificity between two tests: Seven hands were negative for CTS with conventional EDX; out of this number, 6 cases

were negative with inching method. Thus, the specificity of inching method was evaluated: $6/7 \times 100 = 85.71$. Second lumbrical-interossei test was negative in 5 hands out of seven patients with no CTS. The specificity of this test was: $5/7 \times 100 = 71.42$. Therefore, according to this study, inching method was more specific than 2nd lumbrical-interossei test.

Comparison of accuracy between two tests: In our study, the accuracy of inching test was 93.33, whereas this result for second lumbrical-interossei test was 73.33. Comparison of sensitivity and specificity of these two methods is shown in figure 1.

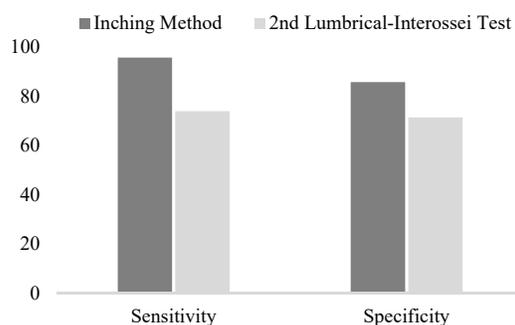


Figure 1. Comparison of sensitivity and specificity between inching method and 2nd lumbrical-interossei test in carpal tunnel syndrome (CTS) in diabetic peripheral neuropathy

Discussion

Among several types of peripheral neuropathies which are associated by DM, DSPN is the most common type.¹ CTS is very common in patients with DM as well.² Since the generalized neuropathy secondary to DM affects peripheral nerves, the diagnosis of CTS with conventional EDX criteria (onset latency of median SNAP or distal latency of median CMAP) is controversial. Therefore, we conducted this study to compare two more diagnostic techniques: inching and second lumbrical-interossei tests. Inching method is a technique that can detect the definite site of the nerve entrapment. This is used for distinguishing the location of compression in carpal tunnel.¹¹ In this study, we considered the difference of distal antidromic sensory latencies of median nerve between 2 points greater than 0.21 ms as abnormal response. The sensitivity and specificity of this technique in our study were 95.65% and 85.71%, respectively. The sensitivity and specificity of inching method for diagnosis of CTS were calculated in the literature previously, but none of

them had been evaluated in patients with underlying diabetic peripheral neuropathy. Seror considered inching test orthodromically and antidromically on sensory fibers of the third digit for 20 cases with mild CTS. Both sensitivity and specificity of the orthodromic sensory inching test were reported 100%. Findings of the study showed that only the orthodromic technique was useful for confirming the diagnosis of mild CTS.¹⁶ The result of this study was somewhat similar to our study probably because of the same sample size and the way to calculate the results. However, there were some differences between them. For example, we just performed the antidromic technique for inching method and compared it with the second lumbrical-interossei test. We included all types of severity of CTS in our study, while only mild forms of CTS were included in the above study. Furthermore, we selected our CTS cases among patients with diabetic peripheral neuropathy, while this was not the case in the above study. One of the best tests for differentiating peripheral neuropathy from CTS is the second lumbrical-interossei test. The interlatency difference between median nerve to second lumbrical and ulnar nerve to second interossei greater than 0.4 ms is considered abnormal. This test evaluates the motor portion of the median nerve, while sensory portion of nerve is affected initially in CTS.¹³ In our study, the sensitivity and specificity of this technique were obtained as 73.91% and 71.42%, respectively. Sensitivity and specificity of second lumbrical-interossei test in CTS for patients with an underlying generalized neuropathy were evaluated by some other researchers. For example, according to Vogt et al. study, lumbrical-interossei latency difference was the best technique in diagnosis of CTS in patients with an underlying polyneuropathy with a specificity of 78%. However, sensitivity of this test was not evaluated in the study.¹⁷ Moreover, Ubogu and Benatar investigated the reliable diagnostic criteria for median-ulnar comparative studies for CTS in patients with generalized neuropathy. They reported 80% sensitivity and 85% specificity for lumbrical-interosseous motor conduction study with a cut-off value of 0.8 ms.¹⁸ As mentioned above, until now, no study has compared second lumbrical-interossei test with inching method. Yagci et al. investigated ninety patients with DM with subgroup of diabetic peripheral neuropathy and CTS. They concluded that lumbrical-interosseous median-ulnar distal latency

difference could identify CTS in these patients better than median-radial sensory distal latency and median-ulnar sensory distal latency differences.¹⁹ Although in this study, second lumbrical-interossei was not compared to inching method, it had the most sensitivity among other comparison techniques for evaluating CTS. Ozben et al. showed a significant association between second lumbrical-interossei distal motor latency difference (2LI-MDLD) and CTS when evaluating 375 hands. The sensitivity of the test was 89.4% and specificity was 84.4% when a cut-off point ≥ 0.5 for 2LI-MDLD was estimated.²⁰ The difference between the sensitivity result of this study with our study can be due to larger sample size of the above study and different cut-off values for motor distal latency of second lumbrical-interossei test. Thus, findings of our study showed that inching method was more sensitive than second lumbrical-interossei test. It can be explained that inching method evaluates sensory portion of median nerve which can be involved in earlier stages of CTS than motor component and evaluates the nerve at short intervals. Furthermore, our study showed that the specificity of inching method was greater than the specificity of second lumbrical-interossei test for diagnosis of CTS in DPN. According to the results of our study, the sensitivity of inching method is greater than specificity of this test as well.

Conclusion

This article revealed that the inching method was more sensitive and specific than the second lumbrical-interossei test for diagnosis of CTS in diabetic peripheral neuropathy with sensitivity and specificity of 95.65% and 85.71%, respectively. Moreover, the sensitivity of inching method was greater than specificity. These findings could be useful for earlier detection of CTS in patients with underlying polyneuropathies.

Conflict of Interests

The authors declare no conflict of interest in this study.

Acknowledgments

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