COMPARATIVE DIAGNOSTIC SENSITIVITY OF INCHING TECHNIQUE WITH OTHER ELECTROPHYSIOLOGIC TESTS OF MILD CARPAL TUNNEL SYNDROME

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ABSTRACT

Objectives: *To study the prevalence of mild carpal tunnel syndrome (CTS). Also, to study the sensitivity and reliability of the inching technique as well as various electrophysiological tests for the diagnosis of mild CTS in a trial to reach an electrophysiological protocol.*

Methods: *All patients referred for electrophysiological studies with clinically suspected CTS over five years' period were included in the study. If distal median motor latency (DML) was less than 4 ms and orthodromic sensory conduction velocity (OSCV) (14 cm wrist, 8 cm palm) was greater than 45 m/s, the patient was diagnosed as mild CTS underwent the following tests: 1- Inching technique, 3rd digit, 2- Median motor nerve stimulation mid palm, 3- Antidromic sensory latency, 3rd digit, split time, 4- Median/ulnar sensory nerve conduction 4th digit global, 5- Median/ulnar sensory nerve conduction study 4th digit, specific, 6- Median & ulnar nerves stimulation 14 cm proximal (antidromic) and ring finger recording, 7- Median/radial sensory nerve conduction study, 1st digit, 8- Electromyography (EMG) was done for exclusion criteria.*

Results: *179 cases were investigated, 43 (24%) were diagnosed as mild CTS. The sensitivity for tests 1, 2, 3 & 4 were (73.3%), for test 5 (50%) and for tests 6 & 7 (32.3%).*

Conclusion: *Inching technique, mid palmer stimulation, Median/ ulnar global & split time are the most sensitive tests in diagnosing mild CTS. If conventional tests fail to diagnose CTS we recommended using mid palmer stimulation & modified inching technique, if failed the most affected finger is examined, ring or thumb.*

INTRODUCTION

The prototypical injury of the median nerve of the wrist joint is either an acute or chronic compressive lesion referred to as carpal tunnel syndrome *(CTS) (Dumitru, 1994).* The prevalence t in USA is 55-125 per 100.000 and in Netherlands is 0.6% in men and 6.8% in women The male to female ratio ranges from 3:1 to 10:1 *(Phalen, 1970 and Dekram et al., 1992).*

Carpal tunnel syndrome is a clinical diagnosis. Symptoms may include numbness and paresthesias in the hand along with pain that can be described as stinging, burning or aching. Occasionally, pain may extend proximally to the elbow or infrequently to the shoulder. Symptoms typically worsen at night, often to the point of waking the patients *(Jackson & Clifford, 1989).* With time complaints begin to occur during the day and in association with activities. Physical examination at first may reveal little objective sensory loss, but with disease progress, some alteration of sensation beginning in the tip of the third or second digits. In advanced cases sensation in the first four digits may be severely impaired and the thenar eminence may be atrophied. Tinel's sign in particular may be abnormal in 45-60% of patients with CTS and in about 30% of patients without *(Phalen, 1970 and Stewart & Eisen 1978).*

Intracanal pressure as measured with a *Wick* catheter is abnormal in CTS patients. However, this is not a practical diagnostic test *(Luchetti et al., 1989).* The best objective diagnostic test continues to be an electrodiagnostic evaluation carefully performed by an expert *(Dumitru, 1994).* In practice, most clinical laboratories encounter examples of abnormal nerve conduction study *(NCS)* in asymptomatic patients as well as symptomatic patients with normal NCS. In patients with clinical CTS, it has been shown that as many as 20% to 25% of CTS cases remained unrecognized by classic electromyographic techniques *(Felsenthal & Spindler, 1979; Carrol, 1987; Redmond & Rivner, 1988; Jackson & Clifford, 1989 and Seror, 1994).*

In CTS, NCS and needle electromyography *(EMG)* are typically ordered to confirm the diagnosis of suspected cases. Although it can rule out other cases *(e.g. neuropathies),* but when electrophysiological values are within normally accepted limits, the diagnosis of CTS is not confirmed and the clinician is placed in a dilemma regarding appropriate therapy. In spite of the normal electrophysiological study with the persistence of symptoms, some surgeons prefer to surgically release the median nerve with most of the time disappearance of symptoms which is a strong evidence of failure of our test to diagnose cases of proved CTS.

Several attempts have been made to increase the diagnostic accuracy of the method with technical improvement since 1967. *Weiderhalt (1970)* reported a technique for assessing CTS measuring nerve conduction velocity by stimulating the finger and recording in the palm & wrist. *Kimura (1979)* reported stimulating at 1 cm intervals from the wrist to the mid palm, *Monga and Laidlow (1982)* suggested examination of more than one digit. *Monga et al. (1985)* suggested measurement of palmer sensory latency, difference between median/ulnar nerve distal sensory latency and examination of all digits. *Jackson & Clifford (1989)* recommended distal sensory latencies differences recorded at the thumb of median & radial nerves, and distal sensory latencies differences recorded at the ring finger after stimulation of the median and ulnar nerve 14 cm proximally at the wrist. *Uncini et al. (1989)* suggested stimulation of the ring finger with a ring electrode and recording at the wrist between the median and the ulnar nerves. *Seror (1994)* suggested specific median, ulnar sensory latencies difference from lateral and medial sides of the inter-phalangeal joint of the ring finger and recording from median & ulnar nerve respectively.

Increasing the test available increases the diagnostic accuracy but at the same time increases complexity of the producers and the examiner will be in a dilemma in selecting the proper test for the specific patient as performing all test is time consuming and also expensive to the patients and sometimes the patients cannot tolerate to continue the examination. Unfortunately in the context of normal conventional NCS & EMG, no diagnostic gold standard exists by which to confirm the presence of clinically significant median nerve compression at wrist.

The Aim Of This Study Was To:

(1) Study the prevalence of mild CTS.

(2) Study the sensitivity & reliability of the inching technique in comparison to various electrophysiological tests for the diagnosis of mild CTS including mid-palmer nerve stimulation, comparison of median & ulnar, median and radial nerves; In a trial to reach an electrophysiological protocol for diagnosing mild CTS.

MATERIALS & METHODS

All patients with clinically suspected median nerve entrapment *(CTS)* at the wrist and referred for electrophysiological confirmation of the diagnosis of CTS at Al Helal Hand Surgery & Rehabilitation Unit over a five years period were included in this study. All patients with history of wrist trauma, DM, history of exposure to toxins, & clinically suspected and/or prospectively *(by electrophysiological test)* proved to have

polyneuropathy, anterior horn cell disease and plexopathy were excluded from the study.

All Patients Were Subjected To The Following Electrophysiological Tests:

- Distal median motor latency *(DML)* - Distal median sensory latency *(DSL)* from PIP of middle finger to wrist - Orthodromic sensory conduction velocity from middle finger to the wrist *(14 cm)* and from the palm to the wrist 8 cm proximal to active recording electrodes.

When distal motor latency was less than 4 cm, distal sensory latency less than 3.3 ms and or when orthodromic sensory conduction velocity *(OSCV)* after palmer stimulation was greater than 45 m/s. *(Buchthal et al., 1974, Kumura, 1979; Dawson et al., 1982; Stevens, 1987; Seror, 1994 and Dumitru, 1994),* the following tests were performed.

Fig.1: (A) The location of the nine stimulation points with recording digital ring electrode. (B) The nine recording of sensory nerve conduction study (SNCS) from normal subject

[1] Inching technique:

The test was performed antidromically on the sensory fibers of the median nerve in the third digit *(Fig.1).* The forearm, wrist and hand were stabilized on a comfortable board. The recording ring electrode was fixed on the proximal interphalangeal joint *(PIP)* of the third digit and the reference electrode distal at 4 cm distal if possible. The stimulating electrode was moved centimeter by centimeter from a point 2 cm proximal to the distal wrist crease *(between the flexor carpi radialis and palmaris longus muscles)* to a point 6 cm distal *(to the third digit)* providing nine measurements. Average was performed when necessary. Latencies were read at the negative peak of sensory action potentials *(SAP).* Normal sensory axons demonstrated a segmental latency shifts between 0.1 - 0.2 ms *(Fig.1).* The test was pathological when at least one centimetric conduction delay was greater than 0.5 ms or more than twice of normal conduction delay *(Brown et al., 1976: Kimura, 1979: Seror, 1989 and Seror, 1994).*

[2] Median motor nerve stimulation mid palm:

Stimulation of the recurrent branch of median nerve in the palm where ring finger touches the base of thenar eminence Normal mid palm amplitude 5-25% > wrist amplitude, conduction block > 20% drop compared to wrist amplitude *(Dumitru, 1994).*

[3] Split Time antidromic sensory latency:

Antidromic latency of the palmer median nerve response recorded at the wrist after stimulation of median sensory fibers 7 cm distally in the second web space between the first two tendons of the finger flexor. The latency obtained is subtracted from 14 cm wrist latency at 3rd digit to determine the time conduction across the carpal tunnel compared with the time from mid palm to digit. The time across the carpal tunnel should always be less than the time for the distal segment *(Dumitru, 1994).*

[4] Median/ulnar sensory nerve conduction study:

(A) Global (classical) median/ulnar with ring finger stimulation:

Stimulation of the ring finger with ring electrode at PIP joint with single recording performed at the wrist between the median and the ulnar nerves. The presence of double peaks potential was pathological *(Uncini et al., 1989).*

(B) Specific median/ulnar latency difference of ring finger:

The stimulations were successively performed on lateral, (median) and medial, *(ulnar)* side of the interphalangeal joint of the ring finger. The recording were performed on median or ulnar nerve depending on which

branches were stimulated. The bipolar surface recording electrode was fixed 1 cm proximal to the distal wrist crease. The latencies were measured at the negative peak; the pathological threshold was 0.4 ms *(Seror, 1994).*

(C) Median/ulnar 14 cm electrodes:

Ring recording electrodes on the ring finger with antidromic stimulation of the median & ulnar nerve 14 cm proximal to active recording electrode Difference between the two distal latencies less than 0.6 ms in normal persons *(Dumitru, 1994).*

[5] Median/radial sensory nerve conduction study from the thumb:

Ring electrodes on 1st digit for recording and the radial nerve stimulated 10 cm along the radius at its palpable crossing of the radius in the distal forearm. Median nerve were excited 10 cm from 1st digit to mid wrist then between flexor carpi radialis and palmaris longus over the median nerve. A difference of more than 0.5 ms considered abnormal *(Johnson et al., 1987 and Dumitru, 1994).*

[6] Needle electromyography (EMG):

Needle EMG for the abductor polices brevis and according to the needed muscle to be examined for exclusion. All the electrophysiological tests were performed on Advantage. Medical 3000TM. The surface electrode was 1 cm discs, spring ring digital electrode and 3 cm disc for grounding. All motor nerve conduction studies were performed with 5 mv/d sweep and 2 mv/d sensitivity, with upper and lower filter setting 10 kHz and 10 Hz. For sensory NCS sweep was 1 ms/d, sensitivity 20 μv/d and lower & upper filter 20 Hz and 2 KHz. Stimulation used for conduction studies was a 0.2 ms rectangular impulse of a variable intensity. The needle EMG was carried using concentric needle electrode with sweep of 10 ms/d, and sensitivity was 2 mv/d with upper & lower filter was 10 KHz and 10 Hz.

RESULTS

One hundred and seventy nine cases were investigated for the presence of carpal tunnel syndrome by electrophysiological tests, 115 (964%) diagnosed as CTS. Conventional methods failed to detect CTS in 43 (24.1%), diagnosed as mild CTS 21 (11.7%) cases were excluded from the study due to accompanying cervical neuropathy, ulnar nerve entrapment, proximal entrapment of the median nerve (pronator tears syndrome), peripheral neuropathy. Percentage of positivity & sensitivity of each of non conventional test was presented in Fig. (2). Inching technique was able to diagnose CTS in 73.3% of cases with sensitivity 73%. The centimeters difference was mainly in third & fourth centimetric sites, 1-2 cm distal to distal wrist crease (Segments 5 & 6), (Fig.3).

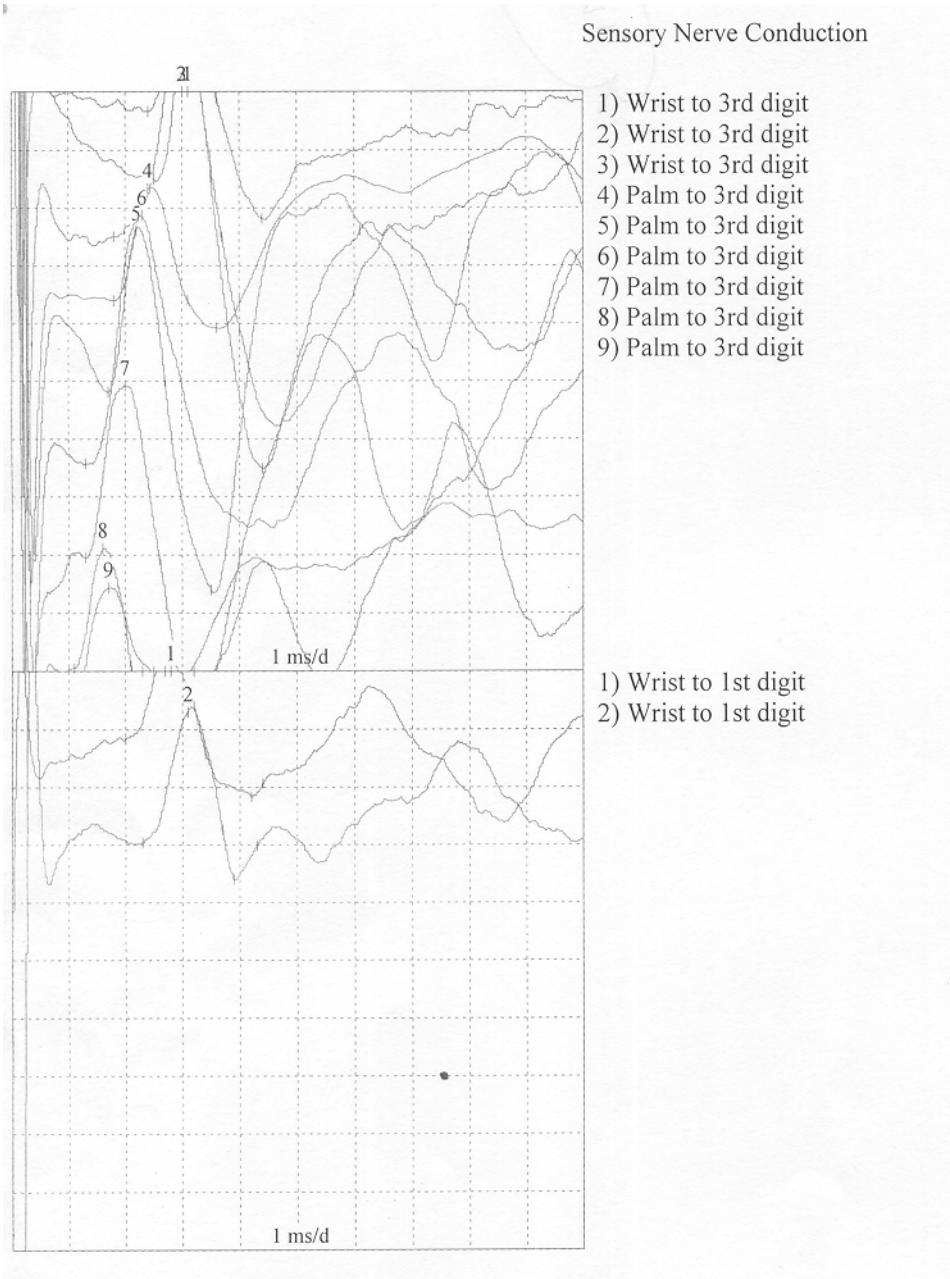

Fig. (2): Representation of positivity of the different seven non conventional tests. (1) Inching technique (2) mid palmer stimulation, (3) split time, (4) Median/ulnar global, (5) Median/ulnar specific, (6) Median/ulnar 14 cm, (7) Median/radial.

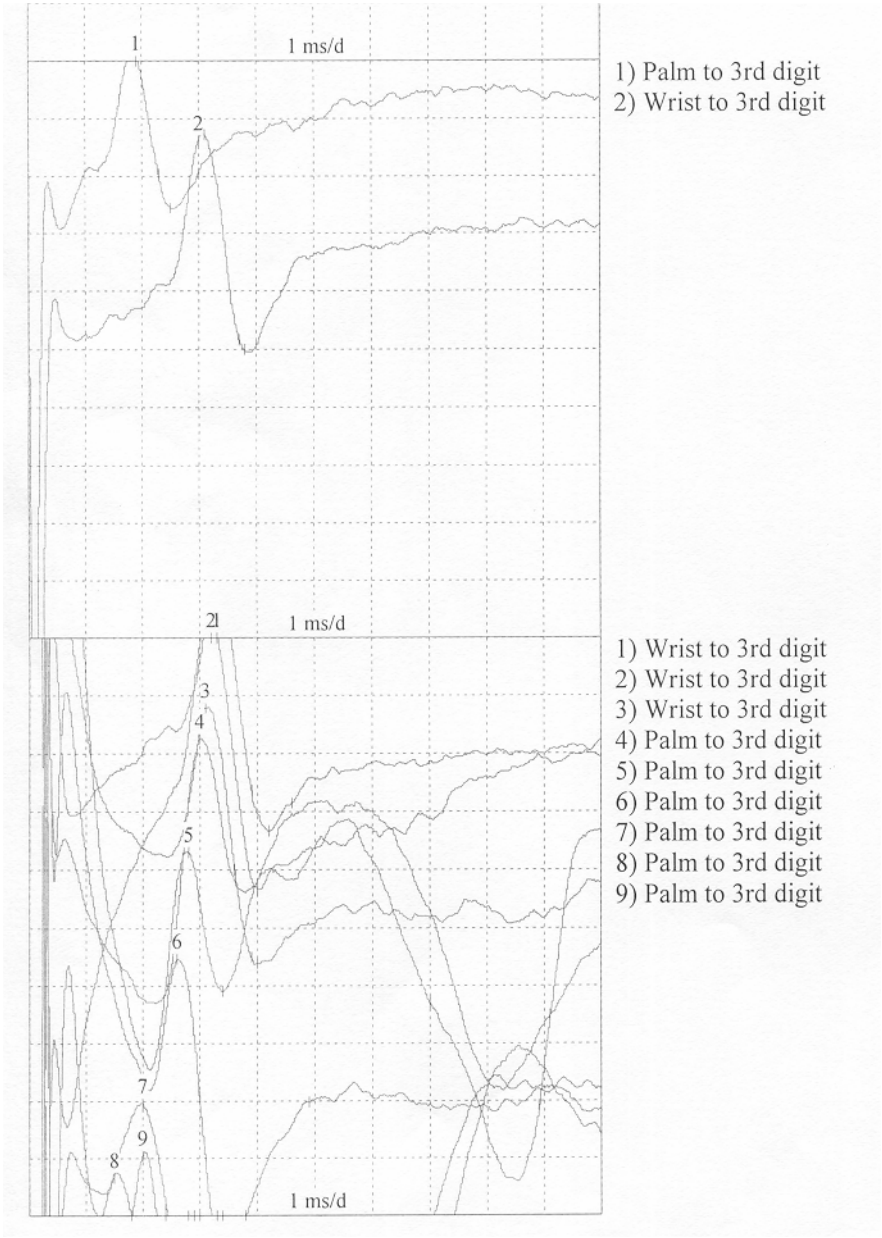

Fig. (3): Nine records of SNCS from a patient with mild CTS showing increased DSL (0.6 ms) with double peak in the 6 segment.

Mid palmer stimulation of the recurrent branch of median nerve was able to diagnose mild CTS in 73% of cases in two cases, mid palmer latencies were more than distal latency. Split time and Median/ulnar global were able to diagnose mild CTS in 73% of cases. Median/ulnar specific was

able to diagnose 50% of cases. Median/ulnar 14 cm, 7 cm & Median/ulnar were able to diagnose 32% of cases.

The results of the NCS of various non-conventional tests using negative peak latencies/ms were:

Mid palmer 2.1 ms.

Split time 1.8 ms.

Median/ulnar 14 cm. Median 3.3 & ulnar 2.7.

Specific median/ulnar. Median 3.2 & ulnar 2.3.

Median/ radial. Median 3.3, radial 3.3

Not all the patients could stand to continue all the tests, 2 patients did not perform median/radial & 2 patients could not continue median/ulnar 14 cm.

DISCUSSION

In this study standard electrophysiological tests failed to detect median nerve entrapment in 43 cases *(24%)* of 179 cases referred with clinical diagnosis of carpal tunnel syndrome for electrophysiological confirmation, that is to say mild CTS. This is in agreement of Seror 1994 but Jackson & Clifford 1989 found the percentage to be 32%. This may be because they used DML & DSL but we used DML, DSL & OSCV.

The aim of this study was to assess the values, sensitivity and reliability of some non conventional electrophysiological tests to diagnose mild carpal tunnel syndrome.

The inching technique was also able to diagnose 73% of cases. *Seror (1998 & 2000)* studied the sensitivity of orthodromic and antidromic inching in mild CTS. He stated that the sensitivity of inching technique will be 85% if we use pathological level of 0.4 ms and decreased to 65% with 0.6 ms pathological level while the specificities were 65-75%. Although the sensitivity of antidromic inching technique varied from 65-85% but it seemed to be specific and reliable test to diagnose CTS as it gives anatomical and functional study of the median nerve across the CT. It has its own normative references of the median nerve outside the entrapment zone. Typically, the location of impaired conduction is at the third & fourth centimetric sites distal to the distal wrist crease, segment 5 & 6. This is in agreement with *Kimura (1979), Stevens (1987) and Nathan et al. (1988, 1989, 1994 & 1998).* The test not only diagnose CTS but can also distinguish between a focal lesion and more diffuse demyelination due to neuropathy or an inflammatory process *(Girlanda et al., 1998).*

But the test has many drawbacks that made *Dumitru (1994)* describe it as impractical as it is time consuming especially with adequate preparation and for the beginner. It also needs use of stronger current intensities or duration which might result in an inaccurate latency measurement because the nerve is excited more distally than anticipated.

Seror (2000) agreed with this opinion and added that the test cannot be performed routinely without major discomfort in recording up to 10 traces and above the thick trans-carpal ligament, the intensities of the stimulus needed to be increased to keep sensory action potential constant which might result in stimulus spread and affect the result. So, he recommended orthodromic technique to avoid this problem, and added that reduced amplitude might occurs above the trans-carpal ligament but without affecting the result as it depends solely on latency criteria, beside this advantage he found that the sensitivity of orthodromic is 100% versus 85% of antidromic concluded that the orthodromic inching technique is superior than the antidromic technique.

Inching technique is not suitable for severe cases due to severe pain and long time of the test *(Dumitru, 1994)* and also no need for more tests if the least costly, easier test to perform can prove CTS. So, inching technique is used only when conventional tests failed to diagnose CTS. *Seror (1994)* added another value for the inching technique in classifying patients with CTS, patients with typical symptoms and negative conventional and inching or centimetric test to be with possible CTS, and probable when orthodromic sensory conduction velocity after palmer stimulation is pathological and classical when distal motor latency and orthodromic sensory conduction velocity are both impaired.

Several ideas has been proposed for increasing the simplicity of the test like using 8 channel recording electromyography with a special multi-electrode. In this case the Tran carpal ligament thickness will not affect the test and it is less time consuming *(Imaoka et al., 1992)* but it is not a standard in most of the laboratories. Seror 2001 modified the test by 2 centimetric incriminations in orthodromic inching technique with sensitivity 94%, the test is very easy & the time for the test allows its routine use.

In this study mid palmer stimulation of the recurrent branch of the median nerve was able to diagnose 73% of cases of mild CTS although not the same cases that were diagnosed with mid palmer stimulation. So, the combination of both, tests may increase the sensitivity of diagnosing mild CTS to 100%. *Dumitru (1994), Lu & Tang (1995) and Kouyoumdjian (1999)* recommended this test to increase the sensitivity of the diagnosis. The so called pure motor carpal tunnel syndrome is rare but should be

considered *(Kimura & Ayyar, 1985).* So, motor techniques are helpful in such patients.

Split time test showed positive cases in 73% of cases with mild CTS. *Stalberg et al. (2000)* found its sensitivity to be 94%. They used an autonomic tester which is a fixed bar containing the stimulating electrode *(distal)* and the bipolar recording electrode set up with 2 poles *(proximally)* at 7 & 14 cm. It is less time consuming *(1 min. /hand)* but it is failed to detect any signal in 70 cases showed abnormality with other routine test, the advantage of the test is that it allows isolation of the affected segment. It also helps in diagnosing peripheral neuropathy. Also the amplitude for the above & below carpal tunnel can be compared to investigate the possibility of conduction block. Measuring the SNCV with calculation of the disto-proximal ratio has been proposed as sensitive technique in diagnosing CTS by *Padua et al. (1996).*

Median/ulnar nerve latency difference was studied by 3 different methods. Global median/ulnar nerve was able to diagnose 2/3 of patients with a sensitivity of 73%. Although we found that the test easy and double peak is easily detected. To the contrary, *Uncini et al. (1989) and Seror (1994)* described it as not very specific or reliable as recording of a double peak sensory action potential is very sensitive to the site of recording electrode and the amplitude ratio between the median & ulnar collateral nerves. The specific median/ulnar latency difference showed 50% positivity. As it stimulates the specific digital branch of both median and ulnar nerve of the ring fingers, the 50% sensitivity was not expected. The test is easy to perform but stimulation causes much pain to the patient in the fingers

Stimulation of the median & ulnar nerves at 14 cm in the wrist with digital recording showed 32% sensitivity. Our results are in agreement with those of *Andary et al. (1996).* They found that median/ulnar sensory difference was the least sensitive test. The absolute latency of the median nerve is frequently compared with the ulnar nerve over a similar short segment. This point is very important, because one does not have a segment with which to compare the median nerve. A peripheral neuropathy that might progress to affect more than the most distal segment of the digital nerve may result in an abnormal conduction across the carpal tunnel, even though the patient does not have CTS. A normal ulnar latency combined with an abnormal median mid palm to wrist latency most likely suggests CTS. Whereas slowing of both nerve may be due to peripheral neuropathy or some other type of ulnar nerve lesion and CTS. When the ulnar latency is abnormal, this technique has a limited value in detecting a focal median neuropathy at the carpal tunnel. In such cases the antidromic 14/7 cm test should be performed *(Dumitru, 1994).*

Some investigators prefer comparing the latencies of ulnar & median nerves from the little & index fingers but the index finger might not be affected early as its fiber lies more posterior in the CT compared with the antero-lateral location of the sensory fiber to the remaining digits *(Sunderland 1978). Jackson & Clifford (1989)* emphasized the value of this test *(index & little finger comparison)* in detecting conduction block. *Rossi et al. (1994)* investigated the sensory neural conduction of median nerve from digits and palmer stimulation in CTS and found that the index finger is the least to be affected.

Comparing the median to radial showed 32% sensitivity it is seemed to be the least effective in detecting mild CTS Kouyoumdjian et al., 2002 found it to be 86-93.3% sensitivity. Comparing median to radial nerves can be performed by stimulating the median & radial nerves by placing the cathode midway between the 2 nerves and recording from 1st digit, 2 peaks is recognized with peak latency difference that is greater than 0.5 ms and absent peak of median nerve can occur in profound CTS (*Jackson & Clifford, 1989 and Kouyoumdjian & Morita, 1999* found it to be 97.8% sensitivity but also when median nerve is not innervating 1st digit *(Dumitru, 1994)* so they are prefer to stimulate the 2 nerves separately, so this test can not be performed unless conventional methods failed to diagnose CTS.

The rational behind comparing median to ulnar & to radial nerves, is that the median nerve can be compared with the other nerves of the same hand or even same finger so the patient can serve as their own control Side to side median nerve latency comparison are of questionable value in patients with bilateral CTS and also the ulnar nerve can not be used unless it is normal. *Kouyoumdjian & Morita (1999) and Kouyoumdjan et al. (2002)* recommended comparing median/radial and median/ulnar from 4th digit as the most accurate & sensitive tests in diagnosing mild CTS. Werner & Andary 2002 showed that median radial or median ulnar is the most sensitive & accurate techniques in diagnosing CTS.

Atroshi et al. (2003) studied the various nerve conduction test in population based CTS to compare the diagnostic accuracy of the various test. They studies 2,466 persons 262 symptomatic & 125 randomly selected asymptomatic. They found that median nerve distal motor latency, digit wrist sensory latency, wrist palm conduction velocity had moderate sensitivity and specificity with low predictive value, while median/ulnar digit wrist sensory latency difference had high diagnostic accuracy, but they stated that this does not necessary applied to the clinical settings. From this study we can conclude that inching technique, mid palmer stimulation, split time and median/ulnar global is the most sensitive tests in diagnosing mild

CTS and intermediate sensitivity for median/ulnar specific and the least is for median/ulnar 14 cm & median/ radial nerve.

Although, it seemed that diagnosing CTS with electrophysiological technique is very simple and beginner can diagnose it but mild CTS with symptoms strongly suggestive of diagnosis with normal electrophysiological technique is really a diagnostic challenge. In practice symptomatic CTS with normal conventional electrophysiological study is a dilemma in lacking a decision for selecting the proper test from so many tests available.

Actually when I have the idea of started the study I thought that the problem is very local & limited but when I reviewed the literature & the published articles I have noticed that although the problem seemed to be old in practice and many investigators have tried to find a solution and with the advanced technology there is continuous effort to find a definite solution.

But increasing the number of the proposed test increases the complexity for the next investigator. In our trial of sharing having a solution I tried to choose the simplest and the most widely accepted tests although large in number but I wanted to reach a definite solution. Regardless of the one's favorite technique, the most symptomatic finger must always be examined in order not to miss the diagnosis, the examiner should be trained and accounted with the different test and have the manuability to select the specific test for the specific patients and the terminology for conventional test should be wide to accept more tests according to the patients needs.

So if conventional tests fail I recommend using the mid palmer stimulation modified inching orthodromic technique. If this fails, the most affected finger should be examined, if thumb, do median radial 10 cm separate stimulation, if ring is affected more, use median ulnar global.

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دراسة مقارنة للحساسية التشخيصية والقدرة الاعتمادية على تقنية التقسيم البوصي واختبارات أخري مختلفة في التشخيص الكهربائي لمتلازمة النفق المعصمي الطفيفة

نهال إبراهيم الششتاوي

قسم والروماتيزم والتأهيل، كلية الطب، جامعة عين شمس

الهدف من البحث:- دراسة انتشار متلازمة النفق المعصمي الطفيفة ودراسة حساسية الاختبارات التشخيصية المختلفة لها.لمحاولة الوصول إلى برتوكول للتشخيص الألكتروفسيولوجي .

الطريقة:- اشتمل البحث على المرضي المحولين لعمل الاختبارات الألكتروفسيولوجية لاحتمال وجود متلازمة النفق المعصمي إكلينيكيا في الفترة من 1999-2002.تم قياس الوقت الطرفي الحركي (أقل من 4 مم / ث) أو قياس الوقت الطرفي الاحساسي (أقل من 3,3 مم /ث) أو سرعة قياس الإحساس عند 14 سم من الرسغ و8 سم من راحة اليد (أكثر من 45متر/ ث) تم إجراء الاختبارات التالية:-

1- اختبار التقسيم البوصي.
2- تنبيه وسط راحة اليد للعصب الأوسط الحركي.
3- الوقت المقسم للعصب الأوسط من الإصبع الوسطي الاحساسي.
4- مقارنة الإحساس للعصب الأوسط والعصب الزندي من الإصبع الأوسط بشكل عام.
5- مقارنة الإحساس للعصب الأوسط والعصب الزندي من الإصبع الأوسط بشكل خاص.
6- تنبيه العصب الأوسط والزندي على بعد 14 سم مع قياس الاستجابة من الإصبع الخاتم.
7- قياس الإحساس من العصب الأوسط والعصب الكعبري من الإصبع الأول.
8- اختبار رسم العضلات(للنقد الاستثنائي).

النتائج:- اشتمل البحث على 179 حالة، تم تشخيص 43 منها (24 %) على أنها متلازمة طفيفة للنفق المعصمي. كانت حساسية الاختبار الأول والثاني والثالث والرابع 73,3 % والخامس 50% والسادس والسابع 32% .

الخلاصة:- استنتج البحث أن اختبار التقسيم البوصي واختبار وسط راحة اليد واختبار مقارنة العصب الأوسط بالزندي العام والوقت المقسم هي أكثر الاختبارات حساسية في تشخيص المرض وانه في حالة عدم قدرة الاختبارات التقليدية على تشخيص المتلازمة فقد أوصى البحث على إجراء اختبار وسط راحة اليد واختبار التقسيم البوصي المحسن وفي حالة عدم قدرتهما يوصي باختبار أكثر الأصابع إصابة سواءً كان الإصبع الخاتم أو الإبهام.