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Original Article

Lumbrical-interosseous recording technique versus routine electrodiagnostic methods in the diagnosis of carpal tunnel syndrome

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ABSTRACT

Objectives: We aimed to evaluate the sensitivity of second lumbrical-interosseous (L-I) technique and to compare the results with other electrophysiological methods in patients with carpal tunnel syndrome (CTS).

Patients and methods: This cross-sectional study was conducted in an electrophysiology laboratory of a university hospital between January 2003 and January 2004. A total of 102 patients with CTS (174 hands) and 40 healthy controls (80 hands) were included. Median motor nerve conduction studies were obtained with recordings from the abductor pollicis brevis (APB), median sensory nerve conduction studies from digits I-III and at palm-wrist segment (P-W), median-ulnar sensory comparison at digit IV (M-U), and median-radial sensory comparison at digit I (M-R) were along with L-I technique.

Results: The highest sensitivities were found in the median sensory conduction velocity across the palm-wrist (88%), and digit I-wrist segments (80%), median motor distal latency over the APB (77%), and L-I study (76%). The specificities of conventional tests were higher than the sensitivity of L-I method (63%).

Conclusion: L-I method has a good diagnostic sensitivity in CTS; however, P-W, median sensory nerve conduction velocity at digit I and median distal motor latency are more sensitive than L-I method. Therefore, L-I method can be applied as a supportive technique in the evaluation of patients with CTS.

Keywords: Carpal tunnel syndrome; electrophysiology; median neuropathy; nerve conduction study.

Carpal tunnel syndrome (CTS), compression of median nerve in the carpal tunnel at the wrist, is the most common entrapment neuropathy. Earliest symptoms are usually sensory and include pain and paresthesia worsening, particularly at night over the first three digits.[1-3] Hand numbness aggravates during repetitive wrist flexion. Thumb abduction and opposition weakness may be present, and atrophy can be seen as a result of involvement of motor branches.

Although CTS can be suspected with symptoms and clinical findings, electrophysiological confirmation is necessary for the definite diagnosis.[4] Clinical and electrophysiological evaluation can yield a diagnosis of CTS with about 90% accuracy.[5]

A variety of electrophysiological methods are used for the diagnosis of CTS. The routine work-up is the median nerve motor conduction study with recording from the abductor pollicis brevis (APB) muscle, and median nerve sensory conduction study from the digits II or III to wrist and from palm to wrist segments. Besides, comparison of median and ulnar sensory latencies from digit IV, and of median and radial nerve from digit I can be done.[2,6]

In addition, there is a technique with recording from the second lumbrical and interosseous muscles with stimulation of median and ulnar nerves, respectively. Yates et al.[7] suggest that as motor fibers of median nerve to thenar muscles course more superficially and anteriorly than lumbrical motor fibers inside the carpal tunnel, they are more likely to be affected from the compression under the flexor retinaculum. Therefore, particularly in severe cases with CTS,

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motor axons innervating lumbrical muscles tend to be less traumatized. Since lumbrical responses remain intact in cases with severe CTS refractory to classical median motor and sensory stimulation, measurements of lumbrical-interosseous (L-I) latency difference may be helpful for establishing the diagnosis.[1] Additionally, this technique is relatively rapid and may decrease the number of nerve conduction tests for the diagnosis of CTS.[8]

In the literature, L-I motor nerve conduction studies (NCS) performed with median-ulnar nerve stimulation were often compared with median sensory or median motor studies. In these studies, the patients were mostly severe CTS. In this study, we aimed to investigated this technique using both median sensory and motor studies in mostly mild or moderate CTS patients.

PATIENTS AND METHODS

This study included the patients with the diagnosis of CTS and healthy individuals as the control group between January 2003 and January 2004. Among those referred to our laboratory, 102 patients with CTS (174 hands), having at least one of the clinical signs and who met one or more electrodiagnostic criteria mentioned below were included.

Clinical diagnostic criteria for CTS were as follows: (i) Pain or paresthesia over the region innervated by the median nerve, *(ii)* pain or paresthesia aggravated at night, *(iii)* loss of strength in thenar muscles, *(iv)* thenar muscle atrophy, *(v)* positive Tinel's sign, and *(vi)* positive Phalen's sign.

Diagnostic electrophysiological criteria for CTS were as follows: (i) abnormal median sensory nerve conduction from digit II or III to wrist, *(ii)* abnormal median sensory nerve conduction from palm to wrist, and *(iii)* prolonged median motor nerve distal latency.[2]

The control group consisted of 40 healthy volunteers (80 hands). Patients with diabetes mellitus, rheumatoid arthritis, tuberculosis, hypothyroidism, wrist trauma, polyneuropathy, and those with clinical findings suggestive of CTS were excluded from the control group.

All patients and control subjects were informed about the study and a written informed consent was obtained from each participant. The Medical Faculty of Marmara University Ethics Committe approved the study. The study was conducted in accordance with the principles of the Declaration of Helsinki.

Electrophysiological methods

The evaluation parameters in this study were as follows: temperature at >31 °C. The instrument used was Medelec Sapphire 4 ME (Medelec Ltd., Surrey, UK).

For motor conduction studies, a bipolar percutaneous stimulator was used. Superficial recording electrodes were placed over APB (at 8 cm distance from the stimulus site), second lumbrical muscle (at 10 cm distance from stimulus site), and second interosseous muscle (at 10 cm distance from stimulus site). A ground electrode was placed between the recording and the stimulating electrodes in all electrophysiological tests.

Filter settings were as follows: 3 Hz-5 kHz for motor NCS and F responses; 20Hz-2kHz for sensory NCS. Sweep durations were 50 ms motor NCS and F responses and 20 ms for sensory NCS. The sensitivity was 1 mV for motor and 20 μV for sensory NCS; and 200 μV for F responses. Supramaximal stimulation was used in motor NCS.

Motor and sensory latencies were accepted as the onset latencies. The amplitude of compound muscle action potential (CMAP) was measured between the negative and positive peaks, and the amplitude of sensory nerve action potential (SNAP) was calculated as the distance from the isoelectric line to negative peak.

Statistical analysis

Statistical analysis was performed using the NCSS 2007 program for Windows (NCSS Statistical System for Windows, Kaysville, UT, USA). Descriptive statistics were expressed in frequency, percentage, mean, and standard deviation (SD). A paired t-test was used to compare two extremities in both groups. Two independent samples t-test was used to compare CTS and control groups, while the chi-square test and Fisher's exact test was used to evaluate qualitative data. Distribution of variables was assessed using the Shapiro-Wilks test. A p value of <0.05 was considered statistically significant with 95% confidence interval.

To calculate the sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), accuracy, and positive likelihood ratio (LR+), a conventional receiver operating characteristic curve was generated and the area under the curve (AUC) was calculated.

RESULTS

Of the study group, five patients were males and 97 patients were females with a mean age of 49.9±10.1 (range: 25 to 65) years. Of the control subjects, five were males and 35 were females with a mean age of 48.0±14.8 (range: 25 to 65) years. There was no significant difference between the two groups (p>0.05) p=0.144. Bilateral CTS was detected in 74 (72.5%), right CTS in 22 (21.5%), and left CTS in six patients (5.9%). Carpal tunnel syndrome was in the dominant hand in 24 patients (23.5%). According to the American Association of Neuromuscular and Electrodiagnostic Medicine (AANEM) classification,[9] mild (37 hands in 21.2%), moderate (96 hands in 55.2%), and severe (41 hands in 23.6%) CTS were found in the study group.

In the CTS group, 92.5% patients had numbness at the affected region, 72.7% had a positive Tinel's sign, 55.7% had a positive Phalen's sign, 8% had thenar atrophy, 2.3% had loss of contralateral muscle strength, and 13.2% had APB weakness. All measurements ±2 standard deviation (SD) above or below the control values were considered abnormal, and diagnostic criteria for CTS were established accordingly. These values are summarized in Table 1.

According to the values obtained from CTS patients and control subjects, there were significant

Table 1. Normal and upper/lower limit values obtained from the control group and comparison with the carpal tunnel syndrome group

Nerve, study (recording)		Control group		CTS group	
	Parameter	Mean±SD	Upper/lower limit*	Mean±SD	*p*
Median motor APB	Distal latency (ms)	3.1±0.4	>3.78	4.5±1.1	0.0001†
	CMAP amplitude (mV)	10.1±3.0	<4.05	9.3±6.2	0.426
	CV (m/s)	59.7±4.5	<50.73	56.3±7.2	0.0001†
	Min F latency (ms)	25.0±1.4	>27.81	27.7±2.9	0.0001†
Median motor (2nd lumbrical)	Latency (ms)	3.2±0.3	>3.86	4.6±1.4	0.0001†
	CMAP amplitude (mV)	3.2±1.2	<0.75	2.2±1.4	0.0001†
Ulnar motor (2nd interosseus)	Latency (ms)	3.1±0.3	>3.62	3.2±0.3	0.001†
	CMAP amplitude (mV)	8.3±1.9	<4.57	7.7±1.9	0.016†
Median-ulnar (lumbrical-interossei)	Lumbrical-interossei motor latency difference (L-I) (Ms)	0.1±0.2	>0.60	1.4±1.3	0.0001†
Ulnar motor (ADM)	Distal latency (ms)	2.4±0.3	>2.86	2.4±0.3	0.142
	CMAP amplitude (mV)	9.1±2.3	<4.57	8.5±2.5	0.043†
	CV (m/s) (forearm)	67.5±5.0	<57.42	65.0±5.5	0.004†
	Min F latency (ms)	24.5±1.3	>27.17	24.8±1.8	0.140
Median sensory (digit IV) (13 cm)	Amplitude (μV)	23.3±8.2	<6.98	18.0±9.1	0.0001†
	CV (m/s)	52.0±7.1	>37.67	46.6±10.5	0.0001†
Median sensory (digit III) (13 cm)	Amplitude (μV)	39.5±12.8	<13.79	26.2±13.7	0.0001†
	CV (m/s)	51.9±5.9	>40.09	38.8±7.1	0.0001†
Median sensory (digit II) (13 cm)	Amplitude (μV)	38.8±14.1	<10.62	28.0±14.3	0.0001†
	CV (m/s)	52.3±6.0	<40.36	39.5±6.7	0.0001†
Median sensory (digit I) (10 cm)	Amplitude (μV)	46.9±17.1	<12.65	26.6±16.1	0.0001†
	CV (m/s)	47.3±4.9	<39.95	34.1±6.8	0.0001†
Median sensory (palm-wrist) (7 cm)	Amplitude (μV)	34.7±13.6	<7.41	21.6±10.3	0.0001†
	CV (m/s)	46.5±4.9	<36.76	31.2±5.8	0.0001†
Radial sensory (digit I) (10 cm)	Amplitude (μV)	15.8±6.0	<3.87	12.4±5.6	0.0001†
	CV (m/s)	49.6±4.8	<39.95	48.4±6.4	0.137
Ulnar sensory (digit IV) (13 cm)	Amplitude (μV)	27.1±10.8	<5.54	26.8±10.5	0.262
	CV (m/s)	55.5±5.3	<45.01	54.1±5.6	0.027†
Ulnar sensory (digit V) (11 cm)	Amplitude (μV)	37.1±12.3	<12.51	37.9±11.9	0.888
	CV (m/s)	51.8±4.9	<42.04	51.3±4.6	0.133
Median-ulnar sensory latency difference at digit IV (M-U)	(ms)	0.2±0.4	>0.89	0.5±0.7	0.0001†
Median-radial sensory latency difference at digit I (M-R)	(ms)	0.1±0.3	>0.60	1.0±0.7	0.0001†

CTS: Carpal tunnel syndrome; SD: Standard deviation; * ±2 SD values; APB: Abductor pollicis brevis; CMAP: Compound muscle action potential; CV: Conduction velocity; ADM: Abductor digiti minimi; †: p<0,05 statistically significant; Two independent samples t-test.

Table 2. Sensitivities, specificities, positive and negative predictive, accuracy and likelihood ratio values according ±2 SD values of electrodiagnostic methods

	Sensitivity	Specificity	PPV	NPV	Accuracy	LR	AUC	95% CI
Median motor distal latency APB	0.77	0.99	0.99	0.64	0.83	2.70	0.957	0.912-0.992
Median digit II-wrist sensory CV	0.64	0.97	0.98	0.52	0.83	2.66	0.940	0.874-0.975
Median digit III-wrist sensory CV	0.75	0.96	0.98	0.60	0.77	2.25	0.934	0.838-0.955
Median palm-wrist sensory CV	0.88	0.97	0.99	0.76	0.81	2.46	0.963	0.893-0.986
Lumbrical interossei motor latency difference (L-I)	0.76	0.63	0.82	0.54	0.82	1.20	0.842	0.727-0.894
Median digit IV latency ulnar digit IV latency	0.60	0.73	0.83	0.45	0.54	1.75	0.671	0.546-0.789
Median digit I latency-radial digit I latency	0.76	0.55	0.79	0.51	0.79	1.23	0.926	0.896-0.957

PPV: Positive predictive value; NPV: Negative predictive value; LR: Likelihood ratio; AUC: Area under ROC curve; CI: Confidence interval; APB: Abductor pollicis brevis; CV: Conduction velocity.

differences in the median motor distal latency (MDL), median minimum F responses, L-I, M-U, M-R, digit I, II, III and palm-wrist (median nerve) latencies, amplitudes, and conduction velocities ($p<0.0001$) (Table 1).

On the other hand, there was no significant difference in the ulnar nerve digit V sensory latencies, amplitudes, ulnar nerve distal motor latencies, and ulnar nerve minimum F responses between the CTS patients and control group ($p>0.05$). Although ulnar nerve conduction velocities in the control group across the wrist-posterior cubital region were significantly lower than those of CTS patients, conduction velocities of both groups were within normal limits.

Sensitivities, specificities, PPV, NPV, accuracy, LR+ and AUC values of the aforementioned diagnostic tests for CTS are given in Table 2. The highest sensitivities were found in the median sensory nerve conduction velocity across the palm-wrist, and digit I-wrist segments, median motor distal latency over the APB muscle, and L-I study. The highest accuracies were found in the median motor distal latency over the APB muscle, L-I study and median sensory nerve conduction velocity across the palm-wrist. Specificities of the conventional

Table 3. Demographic and clinic results of control and carpal tunnel syndrome groups

	Control group			CTS group			
	n	%	Mean±SD	n	%	Mean±SD	*p*
Age (year)			48.0±14.8			49.9±10.1	
Sex							0.144
Male	5			5			
Female	35			97			
Numbness							
(-)	80	100		13	7.5		0.0001
(+)	0	0		161	92.5		
Tinnel +							
(-)	80	100		48	27.6		0.0001
(+)	0	0		126	72.4		
Phalen +							
(-)	80	100		78	44.8		0.0001
(+)	0	0		96	55.2		
Atrophy +							
(-)	80	00		160	92		0.006
(+)	0	0		14	8		
Strength of oppozition +							
4	0	0		4	2.3		0.311
5	80	100		170	97.7		
Strength of abductor pollicis brevis +							
2	0	0		3	1.7		
3	0	0		4	2.3		
4	0	0		16	9.2		χ^2:10.21
5	80	100		151	86.8		<0.05

CTS: Carpal tunnel syndrome; SD: Standard deviation; +Fisher's Exact test.

Table 4. Comparison of right-left hand for all of the patient and control subjects

	Left	Right		
	Mean±SD	Mean±SD	t	*p*
Median motor APB				
Distal latency (ms)	3.0±0.4	3.0±0.3	0.16	0.853
CMAP amplitude (mV)	9.3±2.5	10.5±3.5	-1.46	0.145
CV (m/s)	60.4±5.8	59.4±3.3	0.98	0.332
Min F latency (ms)	24.8±1.4	25.0±1.3	-0.76	0.457
Median motor second lumbrical				
Latency (ms)	3.2±0.3	3.2±0.4	-0.01	0.916
CMAP amplitude (mV)	3.2±1.4	3.1±1.1	0.37	0.736
Ulnar motor second interosseous				
Latency (ms)	3.1±0.3	3.0±0.3	0.40	0.783
CMAP amplitude (mV)	8.3±2.1	8.4±1.9	-0.12	0.907
Ulnar motor				
Distal latency (ms)	2.3±0.3	2.4±0.3	-0.17	0.814
CMAP amplitude (mV)	9.5±2.3	9.1±2.5	0.61	0.489
CV (m/s) (forearm)	67.6±5.3	66.9±5.3	0.59	0.495
Min F latency (ms)	24.4±1.5	24.4±1.3	-0.20	0.853
Median sensory digit 4				
Amplitude (μV)	25.1±7.9	23.7±7.8	0.69	0.548
CV (m/s)	54.1±7.2	52.4±5.8	1.05	0.313
Median sensory digit 3				
Amplitude (μV)	42.7±12.4	38.5±12.6	1.40	0.188
CV (m/s)	52.8±5.0	53.0±6.0	-0.20	0.804
Median sensory digit 2				
Amplitude (μV)	42.5±14.0	38.9±13.5	1.24	0.221
CV (m/s)	53.7±5.9	52.9±5.7	0.60	0.496
Median sensory digit 1				
Amplitude (μV)	49.2±16.8	48.9±16.4	0.08	0.941
CV (m/s)	47.9±4.8	47.9±4.7	0.00	0.998
Median sens. palm-wrist				
Amplitude (μV)	35.1±13.0	35.4±13.8	-0.11	0.907
CV (m/s)	47.3±5.7	46.4±4.1	0.88	0.421
Radial sensory digit 1				
Amplitude (μV)	17.0±5.8	15.6±6.4	1.04	0.310
CV (m/s)	50.3±5.4	49.1±4.5	0.93	0.335
Ulnar sensory digit 4				
Amplitude (μV)	29.5±9.9	27.6±10.9	0.71	0.489
CV (m/s)	56.2±6.0	55.5±4.6	0.51	0.635
Ulnar sensory digit 5				
Amplitude (μV)	39.2±12.3	37.3±12.1	0.66	0.545
CV (m/s)	51.9±3.8	52.7±5.7	-0.72	0.489
Lumbrical-interossei motor latency difference (L-I)	0.1±0.2	0.1±0.2	-0.50	0.635
Median-ulnar sensory latency difference at digit 4 (M-U)	0.1±0.3	0.1±0.3	-0.20	0.853
Median-radial sensory latency difference at digit 1 (M-R)	0.1±0.3	0.1±0.2	0.75	>0.05

Paired t test; SD: Standard deviation; APB: abductor pollicis brevis; CMAP: Compound muscle action potential; CV: Conduction velocity.

tests were usually higher than that of L-I technique (63%).

DISCUSSION

Carpal tunnel syndrome is the most common entrapment neuropathy referred to electromyography laboratories. It is more prevalent in women.[2,10,11] Several studies have shown different ages for the onset of CTS ranging between 45.2 and 51 years.[11-14] In our study, female patients predominated (95.1%) with a mean age of 49.9±10.1 years. In many studies, CTS has been more commonly reported in women.[15-17]

Carpal tunnel syndrome initially affects the dominant hand and, then, involves the contralateral hand. Bilateral involvement was reported in 46.1 to 62% of the cases.[18,19] In a study conducted by

Aydin et al.,[14] the mean age for bilateral and dominant hand involvements were 64.5 and 23.5%, respectively. In our study, we found a higher ratio of bilateral CTS (72.5%), and 23.5% of CTS cases were diagnosed in the dominant side.

Simpson[20] was the first to describe the use of median nerve motor conduction studies as a diagnostic tool in CTS in 1956. Later, Thomas[3] confirmed the Simpson's[20] assumption. Prolongation of median nerve motor distal latencies reportedly varied between 29 and 81% in the literature.[21] In our control group, the median nerve motor distal latencies above 3.78 ms were considered abnormal (>2 SD above the mean value). In our study group, the mean median nerve motor distal latency was 4.53 ms. In another study, the corresponding values were 3.90 ms and 4.64 ms.[22] In the aforementioned study, the sensitivity and specificity of measurements of the median nerve motor distal latencies were 78.2% and >99%, respectively. We found similar values (75 and 99%, respectively) in our study. Preston and Logigian[23] also reported 54% sensitivity of measurements of the median nerve motor distal latency. In their study, Aydin et al.[14] found prolongation of median nerve motor distal latency in approximately 48.6% of their cases, and the mean median nerve motor distal latency was 4.28 ms.

The comparative evaluation of the recordings from the second lumbrical muscles for median distal motor latencies and ulnar distal motor latencies obtained from the interosseous muscles is another technique assessing the sensitivity of motor NCS.[23,24] It has been shown that motor fibers innervating the thenar muscles are relatively protected, compared to motor branches of the lumbrical muscles.[7] In this technique, nerves are stimulated within the same distance used in classical methods. They are obtained from both muscles using a recording electrode placed immediately lateral to the mid-point of third metacarpal head.[23] A difference of >0.4 ms between the median and ulnar latencies recorded from the second lumbrical and interosseous muscles is considered significant.[9]

In our control group, L-I difference values above 0.60 ms were accepted abnormal. In our study, the cut-off value for the L-I latency difference was >0.5 ms. In our CTS group, the mean difference was found to be 1.40 ms, whereas it was 0.12 ms in the control group, indicating a significant difference between the two groups ($p<0.001$) (Table 1).

Boonyapisit et al.[10] reported 6.0 ms for mean L-I value in their severe CTS group, and found the sensitivity of L-I method as 92.8%. In addition, Kodama et al.[25] found the sensitivity of L-I method to be 92%. In our study, we found the sensitivity and specificity of this method to be 76% and 63%, respectively. Preston and Logigan[23] reported the sensitivity of L-I technique as 95%. In another study in patients with mild CTS, Preston et al.[24] reported 88% sensitivity for this method.

Furthermore, Ozben et al.[26] found the sensitivity to be 89.4% and specificity to be 84.4% with a cut-off value of ≥0.5 in their study. However, based on a cut-off value of >0.5 for L-I latency difference, sensitivity and specificity were 86.9% and 91.3%, respectively. The authors, finally, concluded that this technique could be used as a quick and simple technique in very severe CTS cases, providing extra information.

On the other hand, Argyriou et al.[27] reported the second L-I comparison method to be very sensitive to diagnose CTS in mild CTS cases. Banach et al.[28] also found that there was a strong correlation between the diagnosis of CTS and L-I test, compared to other standardized tests.

Generally accepted consensus for the electrodiagnosis of CTS is that median nerve sensory conduction studies are more sensitive than motor conduction methods.[12,21] In 63 to 97.8% of patients with CTS, abnormal sensory nerve conduction results across the digit-wrist segment have been issued.[2] The most frequently seen abnormality in the digit-wrist segment is the absence of compound nerve action potentials (CNAPs). Delayed sensory nerve conduction velocity or prolonged sensory latencies rank second in incidence.[2]

In a study performed in 55 hands, Macdonell et al.[29] reported that the most prominent slowing in median nerve sensory conduction velocity examinations in CTS was seen in digit I, while minimal delay was noted during digit II recordings . In another study conducted in 375 symptomatic hands, the recordings for sensory nerve conduction velocities were abnormal for all hands in 92% of digit III, 80% of digit II, and 64% of digit I, respectively.[30] In an antidromic sensory conduction study performed in 59 patients with mild CTS demonstrated that recordings for digit I were the most sensitive measurements in the detection of decelerations in focal sensory nerve conduction velocities across wrists.[31]

In addition, Aydin et al.[14] found a significant slowing in conduction velocities during the median sensory NCS across digit I (95.4%), digit III (88%), and digit II in decreasing order of frequency.

In our study, sensory nerve conduction velocities across the wrist-digit I, II or III had 80%, 64%, and 75% diagnostic sensitivities. Accordingly, the most sensitive segment for the detection of nerve conduction velocities was digit I-wrist, while the least sensitive one was digit II-wrist segments. Relative protection of the digit II-wrist segment from trauma might be related to the anatomical configuration of median nerve inside the carpal tunnel. Median nerve was also demonstrated most vulnerable to compressive forces at the distal segment of carpal tunnel, where the median nerve divides into motor and sensory branches. At this level, fibers of median nerve passing below transverse carpal ligament and extending to digits I and III run on the anterolateral aspect of the nerve, while those approaching to medial aspect of digit IV parallel the nerve anteromedially. Nerve fibers coursing toward digit II run posteriorly within the confines of central portion of the tunnel. Therefore, it has been suggested that, in CTS , direct compressive or ischemic impact on nerve is not uniformly distributed, and some fibers are more severely affected.[7]

Furthermore, palm-wrist sensory nerve conduction studies have higher additive diagnostic sensitivity for CTS.[6] Kimura[32] diagnosed CTS in 63% of their patients, and adjunctive application of palmar stimulation revealed another 23% of cases with CTS.

Many laboratories consider palm-wrist sensory nerve conduction studies as a standard diagnostic test for CTS.[6] Aydin et al.[14] found prolonged sensory nerve conduction velocities across the palm-digit segments in 98.5% of their cases. Demirci and Sonel[33] investigated which test was more sensitive in patients with early stage CTS and found that the most sensitive tests were palm-wrist test and median/radial-digit I differential latencies test. In our study, the sensitivity of palm-wrist conduction velocity was found to be 88%, indicating the highest rate of diagnostic accuracy among all NCS to date.

To increase the diagnostic accuracy in cases with normal conventional test results, various comparative methods have been suggested.[6] Measurements of median and ulnar-palmar mixed latencies and median/ulnar-digit IV differential latencies are most widely used methods.[33,34] Uncini et al.[35] found sensitivities of measurements of digit IV-wrist median-ulnar differential latencies, median-ulnar palmar mixed latencies, and L-I method to be 77%, 56%, and 10%, respectively. In a study conducted by Preston et al.,[24] the corresponding rates of sensitivity were 91%, 97%, and 88%, respectively.

Among the comparative tests, the record of median-ulnar sensory latency difference of the digit IV commonly used in the diagnosis of CTS. Aygul et al.[36] found the sensitivity of this test to be 77%. In our study, the sensitivity of differential latencies of digit IV-median/ulnar nerves was found to be 60%, which was the lowest rate among all NCS. We believe that our established cut-off value of >0.89 ms for abnormal differential latencies derived from the results of the control group might contribute to this low rate of sensitivity. In the literature, however, the cut-off value for this test is often >0.40 ms. In our cases with CTS, the mean differential M-U latency was found to be 0.5±0.7 ms.

In the comparative NCS with median nerve, radial nerve has been preferred over ulnar nerve due to relatively rare occurrence of entrapment of superficial radial nerve. The differential latency of median-ulnar nerve is <0.5 ms with antidromic stimulation.[9,34] Pease et al.[37] found CTS in 333 patients using conventional methods with 78% sensitivity, while this method yielded 87% sensitivity.

In our study, for the differences in latencies of median-ulnar NCS, the cut-off value was set at 0.60 ms. The sensitivity of this test was 76%. Leblebici et al.[38] and Pease et al.[37] compared median-ulnar and median-radial nerve latency differences in patients with early stage CTS, and both tests were found to be good alternatives to identify early stage CTS patients.[37,38] Eftekharsadat et al.[39] described radial-median latency difference study and wrist segment nerve conduction velocity study using two-segment technique as the most valuable techniques in the diagnosis of CTS.

In general, the sensitivities of amplitude studies in CTS are low. Cioni et al.[30] revealed that measurements of median nerve SNAP amplitudes were much more inferior to those of sensory nerve conduction velocity, and it must be abandoned as a diagnostic test for CTS. In our study, compared to the control group , digit I-IV and palm-wrist median nerve SNAP amplitudes were significantly lower in the patients with CTS. However, the mean SNAP amplitudes recorded in CTS were above abnormal values. Therefore, we consider that CTS diagnosis cannot be made firmly based on the recordings of SNAP amplitudes alone, and nerve conduction velocities must be calculated.

On the contrary, we found lower sensitivity and specificity of second L-I latency difference technique.

The reason for this can be that our study group included 75.6% mild to moderate CTS patients. We believe that, if we had higher rate of severe CTS cases, our values could have been higher. Therefore, the main limitation of our study is that we were unable to evaluate our CTS cases separately according to the grade of involvement. Thus, the sensitivity and specificity of the testing methods of mild, moderate, and serious CTS cases were unable to be evaluated separately.

In conclusion, L-I method has a good diagnostic sensitivity for CTS. However, the sensitivities of median palm-wrist sensory conduction velocity, median digit I-wrist sensory conduction velocity, and median motor distal latency over the APB muscle were higher in our study. Therefore, in the evaluation of cases with CTS, L-I method can be considered as an adjunctive technique. Further large-scale, comparative studies including subgroup analyses for grading the severity of CTS would yield more accurate results about the diagnostic sensitivity of this technique.

Declaration of conflicting interests

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