



*Original Research Article*

## Postoperative Electrophysiological Studies in Carpal Tunnel Syndrome

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### **Abstract**

Carpal Tunnel Syndrome (CTS) is the most common entrapment neuropathy in the upper extremity. The median nerve is compressed within its course through the carpal Tunnel just distal to the wrist crease. Usually Occur in middle aged patients Ratio of female to male = 4: 1. It is bilateral in over 50 % of cases, but is usually worse in the dominant hand. Early diagnosis and treatment are important and result in complete cure, delay can result in irreversible median nerve damage Every patient with carpal tunnel syndrome should be carefully and individually evaluated clinically for proper diagnosis before surgery and thorough search for any associated condition that mimic carpal tunnel syndrome and may be responsible for postoperative complaints. Frequently use postoperative nerve conduction studies for prognostic purposes and to serve as a baseline in determine the postoperative state of median nerve.

A patient with any numbness or tingling in the fingers or with any weakness or atrophy of the thenar muscles must be considered as having carpal tunnel syndrome, unless proves otherwise.

**Key words:** CTS, NCV, MRI, CT SCAN, EMG.

### **الخلاصة**

متلازمة انضغاط العصب الوسطي في منطقة الرسغ هي الأكثر الحالات الشائعة لانضغاط الأعصاب في الأطراف العليا، وتحدث في النساء في منتصف العمر بنسبة أكثر من الرجال 4:1 ويحدث في الجهتين اليمنى واليسرى سوية في 50% من الحالات. التشخيص المبكر والعلاج جدا مهم لشفاء العصب من الانضغاط ومنع الضرر في العصب. التشخيص قبل للعملية مهم جدا لانهاك الكثير من الحالات تشبه متلازمة انضغاط العصب الوسطي بحيث تبقى الأعراض حتى بعد اجراء العملية ويجب إجراء فحص تخطيط الأعصاب والعضلات بعد العملية كمقياس في التحسن والاستجابة منازلة الانضغاط على العصب.

**الكلمات المفتاحية:** متلازمة انضغاط العصب الوسطي، سرعة توصيل العصب، الرنين المغناطيسي قياس كهربائية العضلات، العصب الوسطي.

### **Introduction**

**A**etiology  
Carpal Tunnel is a closed space, and in this space any swelling may cause median nerve compression.

In most cases, no specific etiology can be identified. The following etiologies tend to be more common in younger patients:

- A. **Classic CTS:** chronic time course, usually over a period of months to years  
1. Trauma : often job – related.

- a. Repetitive movements of hand or wrist: carpenters.
  - b. Repeated forceful grasping or pinching of tools or other objects.
  - c. Awkward positions of hand and or wrist, including wrist extension, ulnar deviation, or especially forced wrist flexion.
  - d. Direct pressure over carpal tunnel.
  - e. Use of vibrating hand tools.
2. Systemic conditions:
- a. Obesity.
  - b. Local trauma.
  - c. Pregnancy and lactation.
  - d. D.M.
  - e. Rheumatoid arthritis .
  - f. Mucopolysaccharidosis v .
  - g. Menstrual cycle .
  - h. Contraceptive pills.
  - I. Menopause.
  - J. Pyridoxine deficiency.
  - K. Amyloidosis.
  - L. Chondrocalcinosis.
  - M. Myxedema.
  - W. Acromegaly.
  - O. Athetoid – dystonic cerebral palsy .
3. Patients with A – V dialysis shunts in the forearm have an increased incidence of CTS , possibly on an ischemic basis or possibly from the underlying renal disorder[9,10].
- B. Acute CTS** : symptoms appear suddenly and severely following exertion or trauma.
1. Median artery thrombosis; a persistent median artery 10% of the population.
  2. Hemorrhage or hematoma in the transverse carpal ligament.
  3. Tenosynovitis .
  4. Acute palmar space infection .
  5. Masses: neurofibroma , hemangioma , lipoma , gouty tophus .
- C. Miscellaneous**

1. Burns at the wrist due to oedema in carpal tunnel with compression of the median nerve.
2. Reduction in the capacity of carpal tunnel:
  - A. Ideopathic or familial thickening of transverse carpal ligament.
  - B. Malunion or callus following colles' fracture or fracture of the carpal bones .
  - C. Unreduced dislocation of the wrist or intercarpal joints
  - D. Compression by cast.
3. Paraplegic patients that result from increase in pressure in the canal and repetitive trauma from the use of a wheel chair[11,12,13].

### **Materials and Methods**

Between January 2012 to December 2014, we studied eighty -four patients (102 involved hands) (54 from orthopedic department, Baghdad Teaching Hospital) and (30 from neurosurgical department, Specialized Surgical Hospital).

There were sixty-two women (eighty hands) and twenty two men (twenty two hands). The age incidence of our group patients ranged between twenty to sixty-five years (mean, 42.5 years) There were seventy-seven right hands dominant and seven left hands dominant . There were sixty-five right hands affected and thirty-seven left hands affected. There were sixty-six patients (Unilateral) and eighteen patients (Bilateral). 15 patients had previous operation for CTS. the duration of the patients symptoms ranged from three months to five years (mean, 31 month).

In each patient, carpal tunnel syndrome was diagnosed by historical review, clinically and by preoperative electrophysiological study.

**Table 1:**Data of 84 patients with carpal tunnel syndrome

<b>Data</b>	<b>Total No.</b>
Patients	84
Orthopedic cases	54
Neurosurgical cases	30
Hands	102
Female	62
Male	22
Mean age	42.5 yr.
R. Hand	65
R. dominant	77
Unilateral presentation	66
Bilateral presentation	18
Recurrent from previous operation	15
The mean duration of symptoms	31 months
The mean duration of follow up	14 months

All patients were undergone same surgical procedure surgery (division of transverse carpal ligament).The duration of follow up after surgical release of the carpal ligament-averaged fourteen months.

Each patient was assessed clinically by provocative tests , the strength of abductor pollicis brevis was tested manually, in addition to have preoperative nerve conduction studies performed to all hands using bipolar surface electrodes, with electromyography system and the

results were compared to that of ulnar nerve of same hands.

Roentgenograms of (cervical spine , upper thorax , shoulder joint, elbow joint and wrist joint) was recommended in some patients.Laboratory investigations, (complete blood picture, ESR, blood chemistry and other specific tests) was done .In addition thirty patients were included in our study have other associated conditions, summarized in (Table 2).

**Table 2:** Associated conditions in 30 patients presented with CTS

Associated conditions	No. of Patients
DeQuervain's tenosynovitis	2
Cervical arthritis	7
Trigger thumb	1
Hypothyroid	1
Obesity	1
Hypertension	7
Diabetes mellitus	6
Asymptomatic cervical rib	5

### Operative Technique

Under general anesthesia, patient is supine on operating table, tourniquet (bandage) was applied to upper arm in orthopedic and no tourniquet has been used in neurosurgical cases, the limb rested on a side table with fully supinated position, curvilinear incision about 4 cm in length with the ring, finger axis immediately ulnar to the thenar crease at the base of thenar eminence not cross the distal wrist crease. The skin is reflected, palmar fascia is incised, then the glistening fibers of the flexor retinaculum can be seen. A sharp scalpel was used to cut the transverse fibers, exposing the median nerve protected by its fascia. The flexor retinaculum was divided vertically at its ulnar borders over a dissector which is passed underneath the flexor retinaculum through small cut in the flexor retinaculum, the dissector was raised to ensure that there was no residual constricting band. The median nerve was inspected, also the floor of carpal canal was inspected thoroughly in each hand. No neurolysis was performed in any hand. The wound was closed (only the skin), compression bandage was applied, no drain left in the wound, the tourniquet was

removed. The averageduration of operation was about 10-15 minutes.

### Postoperative care

Immediately postoperative and within the first 24 hour the hand is elevated and the patient is encouraged to actively move the fingers at (metacarpophalangeal and interphalangeal Joints). After 10-12 days sutures are to be removed and patients were advised to gradual return to their usual activities over a period of three weeks and to be reassessed clinically and had repeat nerve conduction study at six-week later, no splint was used

### Results

In our study, patients were divided into three groups according to historical and clinical examination data.

**Group one:** twenty patient (23.8 percent) characterized by intermittent pain and numbness, normal sensory and motor function and negative provocative testy.

**Group two:** fifty five patient (65.4 percent) characterized by persistent pain and numbness with proximal radiation of pain, Sensory examination reveal (normal, paresthesia, hypesthesia) motor examination reveal (normal, weak, waste) thenarmuscles.

**Group three:** nine patients (10.8 percent) characterized by persistent pain and numbness with proximal radiation of pain, marked sensory Loss, with marked weak and waste of thenar muscles.

In both groups, two and three patients were evaluated with sensibility tests, results were recorded in (Table -3).

**Table 3:** Groups of 84 patients with CTS

Group	No . of patients	No . of hands	Tinel's sign	Phalen test	Carpal compression test
<b>I. 23.8%</b>	<b>20 / 84</b>	<b>20 / 102</b>			
<b>II. 65.4%</b>	<b>55 / 84</b>	<b>70 / 102</b>	<b>47</b>	<b>58</b>	<b>25 / 30</b>
<b>III .10.8%</b>	<b>9 / 84</b>	<b>12 / 102</b>	<b>12</b>	<b>12</b>	<b>7 / 7</b>
<b>100 %</b>	<b>84</b>	<b>102</b>	<b>57.8%</b>	<b>68.6 %</b>	<b>86 . 4 %</b>

Results of the electrodiagnostic conduction tests were divided into five groups:

1. (Mild) nineteen hands (18.7%) characterized by normal both sensory and motor distal latency and decrease of either sensory or motor conduction velocity
2. (Mild - moderate) eleven hands (10.8 %) characterized by decrease of either sensory or motor conduction velocity in five hands and prolonged distal motor latency in six hands
3. (Moderate) forty one hands (40.1 %) characterized by prolonged distal sensory latency in eighteen hands, prolonged distal motor latency in three hands, both sensory and motor distal latencies prolonged in

fifteen hands , normal both latencies in five hands .

4. (Moderate-sever) eighteen hands (17.6%) characterized by no sensory response in twelve hands and prolonged of both sensory and motor distal latencies
5. (Sever) thirteen hands (12-8%) characterized by no sensory response in twelve hand and prolonged both sensory and motor distal latencies.

In conclusion forty two hands had prolonged distal sensory latency, nine hand had prolonged distal motor latency, twenty two hands had prolonged sensory and motor distal latencies, twenty nine hands had normal both latencies (Table 4). EMG reveal early denervation pattern in 22 hands of the last three groups.

**Table 4 :** Electrodiagnostic conduction tests data of 84 patients with carpal tunnel syndrome

Groups	No. of hands	No. of patients	Prolong DSL	Prolong DML	Prolong DML,DSL	Normal DSL,DML
I	19/102	16/84				19
19.0%						
II	11/102	10/84		6		5
12.0%						
III	41/102	31/84	18	3	15	5
37.0%						
IV	18/102	16/84	12		6	
19.0%						
V	13/102	11/84	12		1	
13.0%						
100%	102	84	42	9	22	29

DSL: Distal sensory latency; DML : Distal motor latency

Sixty four (62.7%) of the 102 hand had an abnormal median nerve sensory latency. Thirty one (30.3 %) of 102 hand had an abnormal median nerve motor

latency. Twenty two (21.5%) of 102 hands had abnormalities of both motor and sensory nerve conduction (Table 5 )

**Table 5:** Electro diagnostic tests data of 102 handwith carpal tunnel syndrome

Parameter	No. of hands	%
DSL	62 / 102	62.7
DML	31 / 102	30.3
DSL and DML	22 / 102	21.5

**At operation**

1. There was marked thick carpal ligament in most hands,
2. Pseudoneuromata were found in nine patients,
3. Abnormal distal prolongation of flexor digitorumsublimis muscle bellies through the carpal canal were found in seven patients.
4. In 38 % of our study group there was a recognizable cause for their median nerve compression
5. In 44 % there was no definite cause (idiopathic)
6. In 18% there was recurrent from previous operation for CTS .

**Table 6:**Etiology of C.T.S in ٣٢ patients

Cause	No. of patients
Pseudoneuroma	9
Abnormal muscles	7
Colles fracture	6
Rheumatoid arthritis	2
Diabetes	6
Obesity	1
Hypothyroid	1
Total	38%

Recurrent From Previous Operation 15 patients 18% of the eighty four patients, eighteen were bilateral involvement, ten of them operated on both wrists at same time. After surgical release of flexor retinaculum most of cases had good result, pain and numbness were disappeared immediately, but fewer cases had been resolved over period of week.

In most cases full digital range of motion is restored within three to four days, and most of the patients can perform light activities. No complications were recorded.

In our study, reexamination of thirty five (41.6 %) patients had been done, sixteen patients from group (I), twelve patients from group (II), and seven patients from group (III), reassessment had been done

clinically and with electrophysiological study. In group (I), ten patients were followed up for six weeks and six patients were followed up for one year post operatively, the result of operation was excellent, which was proved clinically and by nerve conduction study .

Ingroup (II), twelve patients were followed up, eight patients were followed up for six weeks to three months, and four patients were followed up for more than two years, the results of operation was excellent. which was proved clinically and by nerve conduction study in eleven patients, while only one patient still complaining of mild weak thenar muscles power.

In group (III) seven patients were followed up, two patients were followed up for (3 – 6) months and five patients were followed up for more than two years. The result of

operation was excellent in five patients while only two patients were still complaining of weak thenar muscles power, nerve conduction study reveal slow progression to normal values in comparison

to preoperative values. In the previously mentioned groups, the pain had been disappeared completely and the patients returned to their usual activities (Table 7).

**Table 7:** Result of 35 Patients Followed Up Postoperatively

Groups	No. of Patients	Period of follow up	Sensory function	Motor power	NCV
I	16		normal	normal	normal
	a 10	six-weeks			
	b 6	> 1 year			
II	12				
	a 8	1.5-3 months	diminish	only One Still Weak	Great improvement to normal values
	b 4	> 2 years	normal		
III	7				
	a 2	3-6 months	diminish	Two still Weak	Slow progression to normal values
	b 5	> 2 years	normal		

NCV : Nerve conduction velocity

### **Conclusion**

1. Every patient with carpal tunnel syndrome should be carefully and individually evaluated clinically for proper diagnosis before surgery and thorough search for any associated condition that mimic carpal tunnel syndrome and may be responsible for postoperative complaints.
2. Electrophysiological studies is mandatory in every patients whether the diagnosis is certain or uncertain , to detect or exclude coexisting condition prior to surgery to confirm the diagnosis in correlation to clinical findings.
3. Interthenar incision, is small incision, yield complete exposure of carpal ligament allowing safe sectioning.
4. Sufficient decompression of the median nerve in carpal tunnel syndrome is usually

obtained by simple sectioning of the entire ligament and give dramatic relief .

5. At time of surgery, one must be careful and gentle to look for any pathological condition which may cause carpal tunnel syndrome.

6. It is unnecessary to perform internal neurolysis even in cases with sever compression proved clinically and with electrophysiological study .

7. Patients usually not need hospitalized postoperatively more than 24 hr.

8. We frequently use postoperative nerve conduction studies for prognostic purposes and to serve as a baseline in determine the postoperative state of median nerve

## **Discussion**

Nerve conduction study are commonly performed in the evaluation of the syndrome and provide an objective measure of electrophysiologic changes with attention to the technical detail which is critical in arriving at reliable findings[14]. The information obtained narrow differential diagnosis and help plan treatment and determine prognosis. In the diagnostic evaluation of patients suspected of having the carpal tunnel syndrome, clinical electromyography had been proven to be an extremely valuable laboratory procedures, in recent years several electrodiagnostic criteria have been described for early diagnosis, but diagnosis can be made on the basis of prolonged duration of sensory nerve action potential response [15,16].

The estimation of the ratio of the median to ulnar sensory potential amplitude is a sensitive test and it is particularly useful in those patients who show abnormal latency of median nerve [17].

In our series distal sensory latencies were (62.7%) and only (28.4 %) hands, had normal both latencies but with decrease in nerve velocities. In our series pain and paresthesia disappear immediate in most of them with small number will disappear over a period of seven days, with normal thenar muscles power.

In our series most of patients gets immediate benefit from surgery with few numbers gets benefit over several days, Only three patients out of thirty five on whom follow up have been done still were complained of weak thenar muscles function.

The complications from surgical treatment of the syndrome for the most part must be attributed to poor technique, the greatest number of patients with complication were those whose entire ligament had not been completely released [9].

In our series , no complications were recorded and 15 patients who had previous

operation for CTS has reported again and intraoperatively we found incomplete resected flexor retinaculum, so complete section is mandatory because recurrence of CTS occur with incomplete section .

reassessment had been done clinically and with electrophysiological study postoperative nerve conduction studies were used for prognostic purposes and to serve as a baseline in determine the postoperative state of median nerve

## **References**

- 1.Radford C. Tanzer, Hanover, New\_hampshire, The carpal tunnel syndrome clinical and anatomical study, J. Bone and Joint surg. 41-A/3: 626-634, 1989.
2. McMinn RMH Last' s Anatomy, Regional and applied Churchill livingston. 1990. 8th edition P P 109
- 3.Phalen, G.S. The carpal tunnel syndrome, seventeen years' experience in diagnosis and treatment of 654 hands, J. Bone and .Joint Surg. 48-A/2 March 1996
4. Henry A., Spindler and Lee Dellon, Bultimore, Nerve conduction studies and sensibility testing in carpal tunnel syndrome, J. Hand Surg. 7/3 : 260-363 , May, 1992 .
- 5.Lisanti M, Rosati M, M, Pardi A(1995). Persistant median artery in carpal tunnel syndromeActa. Orthop. Belg 61 :4:315-318.
- 6 .Mesgarzadeh M. Schneck CD, Bonakdarpuor. et. al (1989) Carpal tunnel: MR Imaging Part II. Carpal tunnel syndrome. Radiology, 171 :3:749-754.
7. Rajesh K. Sethi, and Lowery Lee Thompson, The electrographer's Handbook, 2nd. E, 1989
- 8.Casey, E.B., and LeQuesne, P.H. Digital nerve action potentials in healthy subjects and in patients with carpal tunnel syndrome and diabetic Patients, J. Neurol- Neurosurg. Psy. 35 : 612 , 1982.
- 9..C.F. BRADiSH, Carpal Tunnel Syndrome on Haemodialysis, J. Bone and .Joint Surg., 67/1 : 130-132 , Jan. 1985.
- 10.Dawson D.M., Hallet. M., and Millender. L.H. Entrapment Neuropathies. Boston:

little, Brown, 1983.

11. Douglas G. Tompkins, M.D., Lacrosse, Wisconsin, Median neuropathy in the carpal tunnel syndrome caused by tumor like condition. J. Bone and Joint Surg., 49/2 , 737-740, 1987.

12. Herman Robbins. Anatomical study of median nerve in carpal tunnel and the etiologies of carpal tunnel syndrome., J. Bone and Joint Surg. . 45-A/ 5 : 953-965, July, 1993

13. M.H. LEWIS, the median nerve decompression after colle's fracture , J. Bone and Joint surg. 60-B/2 : May, 1998

14. Richard H. Gelberman, Patrick, The carpal tunnel syndrome, study of carpal canal pressure. J. Bone and Joint Surg. 63-A : 380-383, March, 1991

15. GRUNDBERG. A. B. Carpal Tunnel decompression in spite of normal electromyography, J. Hand Surg. 7: 252-259, 1982.

16. LaBan MM mackenzie JR, Zemenlck GA (1998) Anatomic Observations in carpal tunnel syndrome as they relate to the tethered median nerve stress test. Arch. Phys Mad Rehabil. 70 : 11 : 44 – 46.

17. Mesgarzadeh M. Schneck CD, Bonakdarpuor. et. al (1989) Carpal tunnel: MR Imaging Part II. Carpal tunnel syndrome. Radiology, 171 :3:749-754.