DISSERTATION

ON

"EVALUATION OF CLINICAL, ELECTROPHYSIOLOGICAL, AND RADIOLOGICAL PROFILE OF CARPAL TUNNEL SYNDROME"

Submitted in partial fulfilment of

requirements for the degree of

D.M. NEUROLOGY (BRANCH – I)

of

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CERTIFICATE

This is to certify that this dissertation entitled **"EVALUATION OF CLINICAL, ELECTROPHYSIOLOGICAL, AND RADIOLOGICAL PROFILE OF CARPAL TUNNEL SYNDROME"** submitted by **Dr. K. GANESAN** appearing for **D.M. Neurology** Degree (Branch - I) examination in **August 2009** is a bonafide record of work done by him under my direct guidance and supervision in partial fulfillment of regulations of the Tamil Nadu Dr. M.G.R. Medical University, Chennai. I forward this to the Tamil Nadu Dr.M.G.R. Medical University, Chennai, Tamil Nadu, India.

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DECLARATION

I solemnly declare that the dissertation titled "**EVALUATION OF CLINICAL, ELECTROPHYSIOLOGICAL, AND RADIOLOGICAL PROFILE OF CARPAL TUNNEL SYNDROME"** is done by me at Institute of Neurology, Madras Medical College & Govt. General Hospital, Chennai, during 2007-2009 under the guidance and supervision of **Prof. V. NATARAJAN, M.D., D.M.,**

The dissertation is submitted to The Tamil Nadu Dr. M.G.R. Medical University towards the partial fulfillment of requirements for the award of **D.M., degree in Neurology.**

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CONTENTS

INTRODUCTION

Carpal tunnel syndrome (CTS) is the most commonly-encountered entrapment neuropathy with an incidence of 139 per 100,000 person-years for men and 506 per 100,000 person-years for women [125]. The symptoms and signs are caused by compression of the median nerve along the carpal tunnel, which is formed on the distal, medial, and lateral sides by the carpal bones and on the volar surface by the deep transverse carpal ligaments.

The classic symptoms of CTS are numbness and paraesthesia in the first three fingers of the hand, which is commonly exacerbated at night [125]. The diagnostic signs include sensory loss along the lateral aspect of the hand, motor weakness and wasting of abductor pollicis brevis (APB) muscle, and eliciting Tinel's and Phalen's sign at the wrist.

The nerve conduction study (NCS) study is a definite diagnostic test for CTS with high degree of sensitivity and specificity. This test demonstrates a distal lesion of the median nerve and excludes other peripheral conditions resulting in similar symptoms [125,126].Ultrasonography is also an upcoming tool in the diagnosis of carpal tunnel syndrome with equal sensitivity as electrophysiological studies.

The present study is being done to evaluate the clinical profile, electrophysiological severity and radiological profile in patients with symptoms and signs suggestive of carpal tunnel syndrome.

AIM OF THE STUDY

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- To correlate the clinical, electrophysiological and radiological findings in carpal tunnel syndrome.

- To study the etiologic profiles in adult patients aged more than 12 years of age with carpal tunnel syndrome.

- To detect the sensitivity and specificity of various neurophysiological tests and ultrasonogram of wrists in patients with carpal tunnel syndrome.

- To identify the frequency of subclinical impairment on the unaffected side and identify other pathologies which could cause symptoms of carpal tunnel syndrome.

MATERIALS AND METHODS

MATERIALS AND METHODS

Place of study : **Institute of Neurology,**
Government General Hospital,
Madras Medical College,
Chennai -3.

Type of study : Cross sectional, Clinical and Investigatory Study

Duration of study : 2 years (March 2007 to February 2009).

Ethical committee : Present dissertation was approved by the Institutional Ethics Committee.

Consent : Informed written consent was obtained from all the participants.

Collaborating department : **Barnard Institute of Radiology**
Government General Hospital,
Madras Medical College,
Chennai -3.

Case selection

Patients with clinical symptoms suggestive of carpal tunnel syndrome of both sexes were selected from the Neurology OPD, Institute of Neurology, Madras Medical College, Chennai- 3.

A. Inclusion criteria

1. Patients with clinical symptoms and signs of carpal tunnel syndrome of both sexes aged above 12 years.

2. Patients with polyneuropathies associated with clinical symptoms and signs of carpal tunnel syndrome of both sexes aged above 12 years.

B. Exclusion criteria:

1. Patients with age less than 12 years.

2. Patients with incomplete clinical profiles / diagnostic records were excluded.

Limitation of the study:

- Due to technical and administrative reasons, interobserver bias in the ultrasound examination of wrists could not be excluded.

Materials:

The total number of 96 patients who satisfied the inclusion criteria formed the final materials of the present study.

Methods:

All subjects gave their informed consent prior to the study. History taking and detailed neurological evaluation was done in all patients, followed by blood investigations, electrophysiology, and ultrasonogram of both wrists. The findings were entered in the proforma. (Copy of proforma enclosed)

Blood Investigations done included:

1. GTT

2. Thyroid function tests

3. Serum rheumatoid factor

Electrophysiology:

The nerve conduction studies (NCS) and electromyography (EMG) were selected

1) To demonstrate a distal lesion of the median nerve

2) To exclude other peripheral conditions that can result in similar symptoms like proximal median neuropathy, C6-C7 radiculopathy, lesions of the brachial plexus and an attempt was made to correlate the sensitivity and specificity of various neurophysiological tests

Nerve Conduction Study Protocol

A. Routine studies

1) Median motor study recording abductor pollicis brevis. Stimulating wrist and antecubital fossa

2) Ulnar motor study recording abductor digiti minimi. Stimulating wrist, below groove, and above groove

3) Median and ulnar F responses

4) Median sensory response, recording digit 2 or 3, stimulating wrist

5) Ulnar sensory response, recording digit 5, stimulating wrist

B. Median-versus-ulnar comparisons

1) Comparison of the median lumbrical and ulnar interossei distal motor latencies, stimulating the median and ulnar wrist one at a time at identical distances (8-10 em), recording with the same electrode over the 2L/interossei

2) Comparison of the median and ulnar digit 4 sensory latencies, stimulating the median and ulnar wrist one at a time at identical distances (11-13 cm) and recording digit 4

3) F wave latencies of median nerve on symptomatic side were compared with ulnar F wave latencies of that side and with the median nerve F latencies on the asymptomatic side.

If motor & sensory nerve conduction studies showed reduced amplitude of distal CMAP's and SNAP's of median nerve, Palm vs wrist comparison studies were done to differentiate between axonal and conduction block.

C. Palm wrist comparison studies

1) Palm vs wrist motor conduction of median nerve looking for significant increase in CMAP amplitude (distal/proximal ratio >1.2)

2) Palm vs wrist sensory conduction of median nerve looking for significant increase in SNAP amplitude (distal/proximal ratio >1.6)

D. If the ulnar motor and/or sensory studies also are abnormal, **additional nerve (**motor, sensory, F wave**) conduction studies** were done in both upper limbs and lower limbs to rule out brachial plexopathy, C6-C7 radiculopathy, and polyneuropathies.

E. Terminal latency index (TLI):

TLI was calculated in all patients using the following formula

$$TLI = \frac{\text{Terminal distance (mm)}}{\text{CV (m/sec) X TL (msec)}}$$

The sensitivity and specificity of various neurophysiological tests were studied.

Additional EMG studies were done in cases of axonal changes on median motor stimulation and in cases of suspected cervical radiculopathies.

Electromyography protocol

Electromyography of following muscle groups was done.

1) Abductor pollicis brevis (APB)

2) C6-C7 muscles (e.g., pronator teres, triceps brachii, extensor digitorum communis) to exclude a cervical radiculopathy

If APB is abnormal, the following additional muscles were sampled:

1) One proximal median muscle (e.g., flexor carpi radialis, pronator teres, flexor pollicis longus) to exclude a proximal median neuropathy

2) Two other non median, lower trunk/C8-Tl muscles (e.g., first dorsal interosseous, extensor indicis proprius) to exclude a lower trunk brachial plexopathy, polyneuropathy, or C8-T1 radiculopathy

Recorders and Medicare systems electrophysiology machine was used. Conventional methods for the measurement of nerve conduction were employed. The room temperature was kept between 22-24^0 C, and before the testing it was made sure that the limbs were warm enough; at least 32^0 C.

NERVE CONDUCTION STUDIES – NORMAL ADULT VALUES.

1. UPPER EXTREMITY – MOTOR

Nerve	**Recording site**	**Distal latency (ms)**	**Amplitude (mv)**	**Conduction velocity (m/s)**	**Distal distance (cm)**	**F response latency(ms)**
Median	APB	≤ 4.4	≥ 4.0	≥ 49	7	≤ 31
Ulnar	ADM	≤ 3.3	≥ 6.0	≥ 49	7	≤ 32

APB –abductor pollicis brevis, ADM- abductor digiti minimi

2. UPPER EXTREMITY - ANTIDROMIC SENSORY

Nerve	**Recording site**	**Distal latency (ms)**	**Amplitude (μv)**	**Conduction velocity (m/s)**	**Distal distance (cm)**
Median	Digit 2	≤ 3.5	≥ 20	≥ 50	13
Ulnar	Digit 5	≤ 3.1	≥ 17	≥ 50	11

3. MEDIAN – ULNAR INTERNAL COMPARISON STUDIES

Study*		Significant Latency Difference (ms)#
Median motor vs Ulnar motor	Wrist to 2nd lumbrical vs Wrist to interossei	≥0.5
Median sensory vs Ulnar sensory	Wrist to digit 4 vs Wrist to digit 4	≥0.5

* - For each paired study, identical distances are used for both the median and ulnar study (8-10 for motor & 11-13 for sensory).

- Value that exceeds these cutoffs implies focal slowing and is useful in electrodiagnosis of median neuropathy across the carpal tunnel.

4. MEDIAN PALMAR AND WRIST STIMULATION COMPARISON STUDIES

Study*		**Significant Palm to wrist Amplitude Ratio#**
Median motor Median motor	Wrist to APB Palm to APB	>1.2
Median sensory Median sensory	Wrist to digit 2 Palm to digit 2	>1.6

*- Both studies are supramaximal stimulation

- Values that exceed these cutoffs imply some element of conduction block of the median nerve across the carpal tunnel. Values below these cutoffs on distal stimulation imply secondary axonal loss.

5. LOWER EXTREMITY - MOTOR

Nerve	Recording site	Distal latency (ms)	Amplitude (mv)	Conduction velocity (m/s)	F response latency(ms)
Peroneal	EDB	≤ 6.5	≥ 2.0	≥ 44	≤ 56
Tibial	AHB	≤ 5.8	≥ 3.0	≥ 41	≤ 56

EDB- extensor digitalis brevis, AHB – abductor hallucis brevis

6. LOWER EXTREMITY - ANTIDROMIC SENSORY

Nerve	Recording site	Distal latency (ms)	Amplitude (μv)	Conduction velocity (m/s)
Sural	Posterior Ankle	≤4.4	≥ 6	≥ 40

Electrophysiological Parameters Taken To Confirm CTS Were

Median studies:

- Prolonged distal motor latency > 4.4 ms
- Prolonged distal sensory (digit2) latency >3.5ms
- Prolonged minimum F wave latency > 31ms or F waves latency difference between ipsilateral median and ulnar nerves >2ms or F waves latency difference between median nerves of symptomatic side and contralateral side >2ms.
- Terminal latency index < 0.33

Comparison studies:

- Difference between distal motor latency of median and ulnar nerves > 1.1ms
- Difference between distal sensory latency of median and ulnar nerves >0.2ms
- Difference between median and ulnar digit 4 sensory latencies ≥ 0.5ms

- Difference between median lumbrical and ulnar interossei distal motor latencies ≥ 0.5ms

Palm and wrist stimulation comparison

In case of decreased distal amplitude of CMAP'S (<4.2mv) or SNAP's (<20 μv) of median nerve stimulation at wrist, palm and wrist stimulation comparison studies done.

Abnormal if

- Significant increase in amplitude of CMAP's on distal palm stimulation ie, if distal/proximal ratio is >1.2(segmental demyelination with conduction block) or if there is no increase in ratio >1.2 (secondary axonal loss).

- Significant increase in amplitude of SNAP's on distal palm stimulation ie, if distal/proximal ratio is >1.6(segmental demyelination) or if there is no increase in ratio >1.6 (secondary axonal loss).

The Severity of Neurophysiologic Impairment in CTS.

The severity of neurophysiologic CTS impairment is assessed by the neuro physiologic classification by Padua et al[127].

CTS hands are divided into six groups on the basis of the neurophysiologic findings.

Neurophysiological classification (Padua L et al) [127],

STAGING	SENSORY NCS	MOTOR NCS
NEGATIVE	Normal	Normal
MINIMAL	Abnormal segmental and /or comparative test only	Normal distal motor latency
MILD	Abnormal digit-wrist conduction	Normal distal motor latency
MODERATE	Abnormal digit-wrist conduction	Abnormal distal motor latency
SEVERE	Absence of response	Abnormal distal motor latency
EXTREME	Absence of response	Absence of response

In the patients with bilateral CTS, the neurophysiological grade in the more severely affected hand was noted.

ULTRASONOGRAM WRISTS:

Ultrasonography protocol:

All patients underwent high-resolution real-time sonography of the carpal tunnel (both hands) using 7.5 MHz linear array transducer. In initial part of the study, ALOKA ultrasonography machine and in later part of the study SIEMANS ultrasonography machine was used.

The sonographic examination was performed with the patient seated in a comfortable position facing the sonographer, with the forearm resting on the table and the palm

facing up in the neutral position. The volar wrist crease was used as an initial external reference point, with subsequent modifications during

scanning, using carpal bony landmarks and internal reference points. The full course of the median nerve in the carpal tunnel was assessed in both transverse and longitudinal planes. The median nerve is located superficial to the echogenic flexor tendons and its size, shape, echogenicity, and relationship to the surrounding structures and overlying retinaculum were noted. The amount of synovial fluid and the presence or absence of masses was noted.

The continuity of the median nerve and any area of constriction were assessed in both the longitudinal and transverse planes. Measurements were taken for the median nerve at the carpal tunnel inlet proximally.

The mean cross-sectional area of the median nerve was measured by tracing with electronic calipers around the margin of the nerve at the time of sonography (direct tracing). The flattening ratio (defined as

the ratio of the major axis of the median nerve to its minor axis) was also assessed at the tunnel inlet.

Carpal tunnel syndrome was diagnosed when there was

(1) Increased cross-sectional area of the median nerve at the pisiform bone and/or at the hamate bone > 0.09 cm^2.

(2) Increased flattening ratio of the median nerve at the hamate bone >2, or

(3) Increased palmar displacement of the flexor retinaculum> 1mm.

Observation and results

Observation and results

A total of 96 patients aged above 12 years who came to Neurology OPD, Government General Hospital, Chennai between March 2007 to February2009 with clinical features suggestive carpal tunnel syndrome and who satisfied the inclusion and exclusion criteria were included in this study.

- Total number of patients - 96
- Male patients - 28(29.2%)
- Female patients - 68(70.8%)
- Male: Female ratio - 1:2.42

AGE DISTRIBUTION:

- The maximum numbers of patients were in the age group between 40 and 49 years, followed by the age group between 50 and 59, and 30and39 years. Table 1 shows the age distribution in this study

TABLE - 1: AGE DISTRIBUTION

Age group in years	***No. of Patients***	***% of Total Patients (96)***
13-19	-	-
20-29	10	10.41
30-39	19	19.80
40-49	32	33.33
50-59	24	25.00
60-69	7	7.29
70-79	3	3.13
80 & above	1	1.04
Total	**96**	**100**

SEX Distribution:

- There were 28 males (29.2%) and 68 females (70.8%) among the 96 patients in this study.

TABLE 2: SEX DISTRIBUTION IN THIS STUDY

Sex	***No. of Patients***	***% of Total Patients (490)***
Males	28	29.2
Females	68	70.8
Total	***96***	***100***

Age and Sex distribution:

- Males and females predominated in the age group between 40and 49 years.
- Around two thirds of males (64.3%) were in the age group between 30 and 59 years and two-third of females (63.2%) were in the age group between 40 and 59 years. The Table 3 shows age distribution based on sex.

TABLE 3: AGE DISTRIBUTION BASED ON SEX

Age group in years	***Males (%)***	***Females (%)***
13-19	-	-
20-29	3(10.7)	7(10.3)
30-39	5(17.9)	14(20.6)
40-49	8(28.6)	24(35.3)
50-59	5(17.9)	19(27.9)
60-69	4(14.3)	3(4.4)
70-79	2(7.0)	19(1.5)
80 & above	1(3.6)	-
Total	**28*(100)***	**68*(100)***

DURATION OF SYMPTOMS

- Most of the males (35.7%) and females (51.5%) had symptom duration of less than 6 months.

TABLE 4: DURATION OF SYMPTOMS

Duration	Males (%)	Females (%)	Total (%)
< 6 months	10(35.7)	35(51.5)	45(46.9)
6 months – 1 year	9(32.1)	23(33.8)	32(33.3)
1 year – 2 years	4(14.3)	6(8.8)	10(10.4)
2 years and above	5(17.9)	4(5.9)	9(9.4)
Total	28	68	96

DURATION OF SYMPTOMS WITH CTS SEVERITY

- Most of the patients with more than 2 years of symptoms had extreme CTS (88%). Those patients with duration less than 6 months had minimal to mild CTS. As the duration increases, there was a progression from mild to extreme CTS.

TABLE: 5 DURATION OF SYMPTOMS WITH CTS SEVERITY

NCS severity	< 6 months			6 mths – 1 year			1 year - 2years			2 yrs. & above			TOTAL		
	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T
1	5	15	20	-	-	-	-	-	-	-	-	-	5	15	20
2	5	16	21	-	1	1	-	-	-	-	-	-	5	17	22
3	-	4	4	8	22	32	-	-	-	-	-	-	8	26	34
4	-	-	-	1	-	1	4	6	10	1	-	1	6	6	12
5	-	-	-	-	-	-	-	-	-	4	4	8	4	4	8
Total	10	35	45	9	23	32	4	6	10	5	4	9	28	68	96

PARESTHESIAS

- Paresthesias were seen in more than two third (70.8%) of patients. 78.6%

of males and 67.6 % of females with CTS had paresthesias. In patients with paresthesias, median distribution of paresthesias was seen in majority of the patients, 54.5% of males, and 52.1% of females.

TABLE 6: DISTRIBUTION OF PARESTHESIAS

Distribution	Male (%)	Female (%)	Total (%)
Median	12(54.5%)	24 (52.1%)	36(52.9%)
Extra median	10(45.5%)	22(47.8%)	32(47.1%)
Total	22/28(78.6%)	46/68(67.6%)	68/96(70.8%)

- In patients with paresthesias more than two thirds of them had nocturnal paresthesias, 63.6% of males, and 60.9% of females.

TABLE 7: OCCURRENCE OF PARESTHESIAS

Occurrence of paresthesias	Male	Female	Total
Nocturnal	14(63.6%)	28(60.9%)	42(61.8%)
Nocturnal +diurnal	8(36.4%)	18(39.1%)	26(38.2%)
Total	22	46	68

NUMBNESS

- Numbness in median distribution was seen in one third (33.3%) of patients.

TABLE 8: NUMBNESS

Distribution	Male	Female	Total
Median	7(25%)	25(36.8%)	32(33.3%)

ARTHRALGIA /JOINT SWELLING

- Nearly one sixth (15.6%) of patients had joint pains and all were females.

TABLE 9: JOINT PAIN AND SWELLING

	Male	Female	Total
Joint pains & swelling	--	15	15(15.6%)

OCCUPATION

- Majority of females (67.6%) having symptoms were involved in household works. Nearly half of males (60.7%) with symptoms were doing manual work

TABLE 10: OCCUPATION WISE DISTRIBUTION

Occupation	Male	Female	Total
House wife	-	46(67.6%)	46(47.9%)
Construction labour	8(28.6%)	8(11.8%)	16(16.7%)
Agricultural labour	5(17.9%)	-	5(5.2%)
Mechanic	4(14.2%)	-	4(4.2%)
Teacher	2(7.1%)	4(5.9%)	6(6.3%)
College student	1(3.6%)	3(4.4%)	4(4.2%)
Computer operator	1(3.6%)	4(5.9%)	5(5.1%)
Staff nurse	-	3(4.4%)	3(3.1%)
Others	7(25%)	-	7(7.3%)
Total	28	68	96

SENSORY LOSS

- Nearly one third (40.6%) of patients had median distribution of sensory

loss. Two patients had C6-C7 root distribution of sensory loss while ten patients had glove and stocking sensory loss.

TABLE 11: SENSORY LOSS

Distribution	Male	Female	Total
Median	9(32.1%)	30(44.1%)	39(40.6%)
C6-C7 root	1(3.6%)	1(1.5%)	2(2.1%)
Glove & stocking	7(25.0%)	3(4.4%)	10(10.4%)

WEAKNESS OF MEDIAN INNERVATED HAND MUSCLES

- Weakness of median innervated hand muscles (1&2 lumbricals, opponens pollicis, abductor pollicis brevis, flexor pollicis brevis) was seen in one third (39.3%) of males and one fourth (25%) of females.

TABLE 12: WEAKNESS OF MEDIAN INNERVATED HAND MUSCLES

Male	Female	Total
11(39.3%)	17(25%)	28(29.2%)

WASTING OF THENAR MUSCLES

- Wasting of thenar muscles was seen in 10.7% of males and 5.9% of females.

TABLE 13: WASTING OF THENAR MUSCLES

Male	Female	Total
3(10.7%)	4(5.9%)	7(7.3%)

TINEL'S SIGN

- Tinel's sign was positive in 38.5% of individuals. Tinel's sign was positive in nearly one third of males (32.1%) and females (29.2%).

TABLE 14: TINEL'S SIGN

Tinel's sign	Male	Female	Total
Positive	9(32.1%)	28(29.2%)	37(38.5%)

PHALEN'S TEST

- Phalen's test was positive in 64.5% of individuals. Phalen's test was positive in nearly two third of males (64.3%) and females (64.7%).

TABLE 15: PHALEN'S TEST

Phalen's test	Male	Female	Total
Positive	18(64.3%)	44(64.7%)	62(64.5%)

BLOOD INVESTIGATIONS

- Glucose tolerance test was done in all patients and 13(13.5%) patients were diagnosed as diabetics (whose fasting blood glucose >126mg% and/or 2 hours post meal blood glucose > 200mg %).
- Diabetes was most commonly seen in males (28.6%) than females (7.4%).

- Thyroid function tests were done in all patients and 7(7.3%) patients were found to have hypothyroidism.
- Rheumatoid factor estimation was done in all patients and it was exclusively positive in 18.8 %.(all were females).

TABLE 16: BLOOD INVESTIGATIONS

Investigation	Male	Female	Total
Diabetes	8(28.6%)	5(7.4%)	13(13.5%)
Hypothyroidism	1(3.6%)	6(8.8%)	7(7.3%)
RA factor + ve	-	18(26.5%)	18(18.8%)

SYMPTOMS

- Nearly half of the patients had bilateral symptoms on presentation.

0TABLE 17: SYMPTOMS

Symptoms	Male	Female	Total
Bilateral	14(50%)	38(55.9%)	52(54.2%)
Unilateral	14(50%)	30(44.1%)	44(45.8%)
Total	28	68	96

UNILATERAL SYMPTOMS

- Nearly two thirds (65.9%) of patients had symptoms in dominant hand and one third (34.1%) of patients in their nondominant hands

TABLE 18: UNILATERAL SYMPTOMS

Symptoms	Male	Female	Total
Dominant	10	19	29(65.9%)
Non dominant	4	11	15(34.1%)
Total	14	30	44

ETIOLOGY

- Majority of patients had no obvious cause (44.8%) for CTS and were considered to be idiopathic.
- Diabetes was the 2nd common cause in males (28.6%) whereas rheumatoid arthritis was the 2nd common cause among females (26.5%).
- Polyneuropathy was the third common cause of CTS in males (14.3%) and hypothyroidism in females (8.8%).
- C6-C7 radiculopathy was mimicking CTS in one male and one female patient. C8 -T1radiculopathy was seen in another male patient.
- Previous history of trauma with injury to the wrist was obtained in three male patients.
- Out of 3 pregnant females 1 was a primigravida with pregnancy induced hypertension (PIH) and other 2 were multigravida without any comorbid illness.

TABLE 19: ETIOLOGY

Etiology	Male	Female	Total
Idiopathic	10(35.7%)	33(48.5%)	43(44.8%)
Diabetes	8(28.6%)	5(7.4%)	13(13.5%)
Rheumatoid arthritis	-	18(26.5%)	18(18.8%)
Hypothyroidism	1(3.6%)	6(8.8%)	7(7.3%)
Pregnancy	-	3(4.4%)	3(3.1%)
Polyneuropathy	4(14.3%)	2(2.9%)	6(6.3%)
Trauma	3(10.7%)	-	3(3.1%)
Radiculopathy	2(7.1%)	1(1.5%)	3(3.1%)
Total	28	68	96

BILATERAL CTS WITH ASYMPTOMATIC INVOLVEMENT OF OTHER HAND DETECTED ON NERVE CONDUCTION STUDIES

- 19 out of 41(46.3%) patients with unilateral symptoms showed subclinical CTS in the other hand also after nerve conduction studies. After NCS nearly three fourths (76.3%) of patients had bilateral carpal tunnel syndrome.

- Almost two thirds of male (69.2%) and three fourths of female (79.1%) patients had bilateral carpal tunnel syndrome (CTS) after electrophysiology. 3 patients with radiculopathy mimicking CTS with unilateral symptoms were excluded.

TABLE 20:

BILATERAL CTS AFTER NERVE CONDUCTION STUDIES

Symptoms	Male	Female	Total
Bilateral CTS	14(50.0%)	38(55.8%)	52(54.2%)
Asymptomatic CTS in other hand detected by NCS in patients with unilateral symptoms	4	15	19
Total	18(69.2%)	53(79.1%)	71(76.3%)

UNILATERAL CTS AFTER NERVE CONDUCTION STUDIES

Unilateral CTS	8	14	22(23.7%)

- So 71 patients (18 males and 53 females) had bilateral CTS and 22 patients (8 males and 14 females) had unilateral CTS.

- So a total of 186 hands were examined and 164 confirmed hands with CTS were included in the study.

ELECTROPHYSIOLOGICAL GRADING OF SEVERITY OF CARPAL TUNNEL SYNDROME (Padua et al[127])

- In the patients with bilateral CTS, the electrophysiological grade in the more severely affected hand was noted.

TABLE 21: ELECTROPHYSIOLOGICAL GRADING OF SEVERITY OF CTS

Staging	Male	Female	Total
Minimal	5	15	20 (21.5%)
Mild	5	17	22(23.7%)
Moderate	7	25	32(34.4%)
Severe	6	6	12(12.9%)
Extreme	3	4	7(7.5%)
Total	26	67	93

A. IDIOPATHIC

- Nearly two third (62.7%) of the idiopathic carpal tunnel syndrome patients had mild to moderate CTS

TABLE: 22. GRADING IN IDIOPATHIC PATIENTS

Staging	Male	Female	Total
Minimal	3(30%)	7(21.2%)	10(23.3%)
Mild	2(20%)	11(33.3%)	13(30.2%)
Moderate	2(20%)	12(36.4%)	14(32.5%)
Severe	2(20%)	2(6.1%)	4(9.3%)
Extreme	1(20%)	1(3.0%)	2(4.7%)
Total	10	33	43

B.RHEUMATOID ARTHRITIS

- Nearly two third (66.6%) of CTS patients with rheumatoid arthritis had mild to moderate CTS

TABLE: 23. GRADING IN RHEUMATOID ARTHRITIS PATIENTS

Staging	Male	Female	Total
Minimal	-	4	4(22.2%)
Mild	-	4	4(22.2%)
Moderate	-	8	8(44.4%)
Severe	-	1	1(5.6%)
Extreme	-	1	1(5.6%)
Total	-	18	18

C.DIABETES

- Nearly one third (31%) of patients with diabetes had severe to extreme CTS.

TABLE: 24: GRADING IN DIABETES PATIENTS

Staging	Male	Female	Total
Minimal	2	1	3(23.0%)
Mild	2	1	3(23.0%)
Moderate	2	1	3(23.0%)
Severe	1	1	2(15.5%)
Extreme	1	1	2(15.5%)
Total	8	5	13

D.HYPOTHYROIDISM

- 6 out of the total 7 patients with hypothyroidism were females.

TABLE 25: GRADING IN HYPOTHYROID PATIENTS

Staging	Male	Female	Total
Minimal	-	2	2(28.7%)
Mild	-	1	1(14.2%)
Moderate	1	1	2(28.7%)
Severe	-	1	1(14.2%)
Extreme	-	1	1(14.2%)
Total	1	6	7

E.POLYNEUROPATHY

- More than 80% patients with polyneuropathy have moderate to severe CTS.

TABLE 26: GRADING IN POLYNEUROPATHY PATIENTS

Staging	Male	Female	Total
Minimal	-	-	-
Mild	1	-	1(16.7%)
Moderate	2	1	3(50.0%)
Severe	1	1	2(33.3%)
Extreme	-	-	-
Total	4	2	6

F.PREGNANCY

- Of 3 pregnant women with CTS 1 had bilateral minimal CTS and 2 had bilateral moderate CTS.

TABLE: 27: GRADING IN PREGNANT PATIENTS

Staging	Female	Total
Minimal	1	1
Mild	-	-
Moderate	2	2
Severe	-	-
Extreme	-	-
Total	3	3

G. TRAUMA

- Of 3 patients with trauma 1 had healed Colles' fracture right wrist and 2 had history of trauma wrists in their symptomatic hands.

TABLE: 28 TRAUMA

Staging	Male	Female	Total
Minimal	-	-	-
Mild	-	-	-
Moderate	-	-	-
Severe	2	-	2
Extreme	1	-	1
Total	3	-	3

SENSITIVITY OF VARIOUS ELECTROPHYSIOLOGICAL STUDIES

- Of the various electrophysiological tests done, digit 4 sensory median ulnar comparison study was most sensitive (92.1%) followed by F wave comparison studies (87.2%).terminal latency index was least sensitive(54.8%).

TABLE: 29 A. DIGIT 2 SENSORY NCS

SNAP's	
Prolonged distal latency/ Decreased amplitudes	112
Absent SNAP's	19
Total	**131(79.9%)**

TABLE: 29 B**.** MEDIAN MOTOR NCS

CMAP's	
Prolonged distal latency/ Decreased amplitudes	92
Absent CMAP's	7
Total	**99(60.3%)**

TABLE: 29 C. F WAVES

F WAVE	
Abnormal F-wave latency	136
Absent CMAP's	7
Total	**143(87.2%)**

TABLE: 29 D. DIGIT 4 SENSORY

SNAP	
Abnormal (>0.5msec difference)	132
Absent SNAP's	19
Total	**143(92.1%)**

TABLE: 29 E. 2nd LUMBRICAL/INTEROSSEI

Abnormal (>0.5msec difference)	**106(64.6%)**

TABLE: 29 F.TERMINAL LATENCY INDEX

Abnormal	**90(54.8%)**

EMG

- 3 out of 7 patients with extreme CTS showed neurogenic pattern on EMG of Abductor pollicis brevis.

- Of the 3 patients 1 was a male patient with trauma, another was a male patient with no obvious cause and the third was a female with rheumatoid arthritis.

- The remaining 4 patients (1 male and 3 female) patients had conduction block which was confirmed by palm and wrist stimulation motor comparison study which showed distal/proximal ratio difference in amplitude of >1.2.

- 2 patients (1 male & 1 female) showed neurogenic pattern on EMG of the following muscles (Pronator teres & triceps) and were found to have C6-C7 radiculopathy.

- 1 male patient showed neurogenic pattern in 1st dorsal interossei, abductor digiti minimi in addition to abductor pollicis brevis and was found to have C8-T1 radiculopathy.

ULTRASONOGRAM BOTH WRISTS

- Ultrasonogram showed evidence of CTS in 59 of 93(63.5%) patients with CTS.

- In addition to increased median nerve cross sectional area ,USG also showed swelling of tendon sheaths in 12 female patients with rheumatoid arthritis.

TABLE: 30. ULTRASONOGRAM

USG	Male	Female	Total
Abnormal (Median nerve Cross sectional area >0.09 cm^2 at carpal tunnel inlet)	17	42	59 (63.5%)
Normal	9	25	34
Total	26	67	93

Electrophysiological staging wise USG both wrists

- Ultrasonography detected abnormalities in late stages of CTS better than early stages

TABLE 31: Electrophysiological staging wise USG both wrists

Staging	Abnormal			Normal		
	M	F	T	M	F	T
1	1	1	2	4	14	18
2	5	15	20	-	2	2
3	4	16	20	3	9	12
4	4	6	10	2	-	2
5	3	4	7	-	-	-
Total	17	42	59	9	25	34

DISCUSSION

DISCUSSION

SEX DISTRIBUTION

The present study, showed a female preponderance in carpal tunnel syndrome patients. Of 96 patients, 70.8 were females and 29.2% were males. The male: female ratio was 1: 2.42.

According to the study by Mondelli et al, carpal tunnel syndrome (CTS) is the most commonly-encountered entrapment neuropathy with an incidence more in women than men.[96] In the studies done by Phalen et al, and Radecki P et al.[97,98] 3-4 times higher incidence of carpal tunnel syndrome in females have been quoted. In a recent surveillance study from Canterbury and Huddersfield, UK, Bland *et al* [99]reported female to male ratio of 2.07. The present study showed almost similar findings as the above studies.

AGE DISTRIBUTION

Maximum number of patients in our study were in the age group between 40 and 49 years (33.33%), followed by the age group between 50 and 59 years (25.00%).

According to the study by Tay L B[100] et al, more than two-thirds of the patients in their study were between 40 and 70 years of age.

In the present study also more than two thirds (65.6%) belong to 40 – 70 years of age.

DURATION OF SYMPTOMS

In the present study, 46.9% of individuals had symptom duration of less than 6 months. These patients with duration of less than 6 months had minimal to mild CTS. Most of the patients with more than 2 years of symptoms had extreme CTS (88%). As the duration increases there was a progression from mild to extreme CTS.

In the study by Urkude et al[100] the median duration of symptoms for mild, moderate, and severe CTS were two months, four months and 12 months, respectively, suggesting the increasing severity of CTS with longer duration of symptoms.

The above finding very well correlates with the present study that severity of CTS increases with the duration of symptoms.

PARESTHESIAS

Paresthesias were seen in more than two third (70.8%) of patients. 78.6% of males and 67.6 % of females with CTS had paresthesias. In patients with paresthesias, median distribution of paresthesias was seen in majority (52.9%). More than two thirds (61.8%) of patients with paresthesias had nocturnal paresthesias. ie, 63.6% of males, and 60.9% of females.

In Kendall's[103] series of 327 patients, 313 (95.7%) reported paresthesia; 118 (38%) reported nocturnal symptoms only, 178 (58%) reported symptoms during the day and night, but worse at night.

Symptoms of nocturnal paraesthesia are reported to be 51-96% sensitive and 27-68%

specific as per the studies by Szabo RM et al, Buch-Jaeger et al, and Gupta SK et al.[58-61].

In another study by **Tay L B**[100]et al. paresthesia was present in 70.1% patients.

The present study showed similar results as the study by Tay L B et al.

NUMBNESS

Numbness in median distribution was seen in one third (33.3%) of patients. Numbness was present in 19.4% patients in a study by **Tay L B**[100]et al.

OCCUPATION

Majority of females (67.6%) having symptoms were housewives engaged in household works. Nearly half of males (60.7%) with symptoms were doing manual work

Experimental studies have shown a higher incidence of CTS in workers who are involved in high force and repetitive work compared to workers who are not. [28-31]. Silverstein BA et al[28] noted a prevalence of 5.6% among workers in high force and high repetitive jobs compared to 0.6% among workers in low force and low repetitive jobs.

Palmer *et al*[53], found that the regular use of hand-held vibrating tools increased the risk of CTS by more than 2-fold. They also found substantial evidence for high risk of CTS in occupations requiring high repetitive flexion and extension at wrist and also forceful grip[53]. However, they did not find evidence

between the work on keyboard and computers and CTS.

Similar to the above studies, our study also showed majority of the patients with symptoms of CTS were house wives and manual laborers who were involved in high force and repetitive jobs. Our studies also showed that, relatively few (5.1%) of the total patients were computer operators.

SENSORY LOSS, WEAKNESS, AND WASTING

In our study, nearly one third (40.6%) of patients had median distribution of sensory loss. Weakness of median innervated hand muscles (1&2 lumbricals, opponens pollicis, abductor pollicis brevis, flexor pollicis brevis) was seen in one third (29.2%) of patients. Wasting of thenar muscles was seen in 7.3% of patients.

Thenar atrophy is a late sign and signifies significant functional loss. Finger weakness associated with an inability to pinch or frequent dropping of grasped objects, follows

involvement of the motor component. Long-term involvement leads to thenar muscle atrophy with associated loss of thumb abduction and opposition strength. Thenar atrophy is seldom noticed by patients and may not be obvious even to the examiner when examined by looking down onto the palm. However, it will be readily appreciated by comparing both palms together.

Tay L B[100]et al. in their study found APB weakness in 10.5% patients and APB muscle wasting in10.4% patients.

In Phalen's [15]series the atrophy of abductor pollicis brevis, opponens pollicis, and flexor pollicis brevis was noted in 41% of hands.

In our study, patients showed more of weakness than wasting of thenar muscles.

TINEL'S SIGN & PHALEN'S TEST

In the present study, Tinel's sign was positive in 38.5% of individuals. Phalen's test was positive in 64.5% of individuals.

The Tinel's sign is associated with sensitivities of 23% to 67%, and specificities of 55% to 100%[59,60,65,67-71]according to various studies by Kuhlman KA et al, Buch-Jaeger et al, and Katz JN. et al.

In a review, Kuschner *et al*[67] summarized the frequency of Tinel's sign and reported that it is positive from 8% to 100% of CTS patients. Tinel's sign is the least accurate test according to Mondelli *et al*[71]*,* who did not find a combination of signs more useful than a single sign alone.

The reported sensitivity of Phalen's test ranges between 10% and 91% and specificity between 33% and 100%[59, 60, 68, 69, 73-75].

Tinel's and Phalen's sign were positive in 33.6% and 23.9% of patients respectively in the study by Tay L B[100] et al.

In our study sensitivity of the Tinel's sign and Phalen's test are 38.5%and 64.5% respectively.

BILATERAL VS UNILATERAL CTS

In our study, nearly half (54.2%) of the patients had bilateral symptoms on

presentation. 50% of male patients and 55.9% of female patients had bilateral symptoms at presentation. Nearly two thirds (65.9%) of patients had symptoms in dominant hand and one third (34.1%) of patients in their nondominant hands.

Based on NCS nearly three fourths (76.3%) of patients had bilateral carpal tunnel syndrome and one fourth(23.7%) of patients had unilateral CTS. 19 out of 41 (46.3%) patients with unilateral symptoms showed subclinical CTS in the other hand also on nerve conduction studies.

After electrophysiology nearly two thirds of male (69.2%) and three fourths of female (79.1%) patients were detected to have bilateral carpal tunnel syndrome (CTS). 3 patients with radiculopathy mimicking CTS with unilateral symptoms were excluded.

Tay L B[100]et al in their study found that NCS revealed bilateral CTS in 108 (80.6%) and unilateral CTS in 26 (19.4%). There were 35 patients (32.4%) with bilateral CTS being symptomatic unilaterally. Dominant hand involvement was present in 124 patients (92.3%).

In recent publications, by Jablecki CK et al & Padua L et al, the incidence of bilateral symptoms has been reported to be between 60% and 87%, [104,105]

A. E. Bagatur et al[106] reported the incidence of bilateral symptoms as 59% at presentation and found in their group with unilateral symptoms, more than half had positive electrodiagnostic test results in the asymptomatic, contralateral hand.

Likewise, Corwin and Kasdan[107] using electrodiagnosis, reported that median neuropathy at the wrist may occur in asymptomatic individuals.

Bendler et al[108] also found that 38% of the patients in their series who complained only of unilateral symptoms were shown to have bilateral neurophysiological impairment of the median nerve.

Padua et al[105] found similar circumstances in about half of the asymptomatic hands.

Our study is also consistent with the above mentioned findings in various studies that NCS can detect subclinical CTS in asymptomatic hands.

ETIOLOGY

IDIOPATHIC:

Majority of patients (44.8%) had no obvious cause, were considered to be idiopathic. 35.7% of males, and 48.5% of females had no obvious cause. Nearly two thirds (62.7%) of the idiopathic carpal tunnel syndrome patients had mild to moderate CTS. Almost 14% of idiopathic patients had severe to extreme CTS. Most of the idiopathic CTS (82%) patients had severity of CTS more in their dominant hands.

Reinstein L. et al [111] have stressed that 'idiopathic CTS' is a bilateral disorder and that it occurs slightly more frequently in the dominant hand.

DIABETES:

Diabetes was present in 13.5% of patient in our study. Diabetes was the 2nd common cause in males (28.6%) and present in 7.4% of the females in our study. Of the 13 patient with diabetes, 3 males and 1 female presented with polyneuropathy. Nearly two third (66%) of patients with diabetes had mild to moderate CTS. Nearly one third (31%) of patients with diabetes had severe to extreme CTS. In the 4 patients with

diabetic polyneuropathy, 2 had severe CTS, 1 had moderate CTS and 1had mild CTS.

In the study by Urkude R, et al [100] diabetes mellitus was present in 13.4% patients with CTS. Diabetes mellitus is a very commonly occurring systemic disease that is also associated with the presence of CTS. Carpal Tunnel Syndrome develops in 6% of all Type 2 Diabetes sufferers. Median nerve compression is only one of its many complications .[109] According to Dellon et al[110], in diabetic patients, the median nerve, as in their other peripheral nerves, is already involved by a polyneuropathy, and is more easily subject to compression.

RHEUMATOID ARTHRITIS:

In our study all the 18 rheumatoid arthritis patients were females and all had carpal tunnel syndrome. Rheumatoid arthritis was the 2nd common cause of CTS among females (26.5%). Most of the patients (88.8%) with rheumatoid arthritis had minimal to moderate CTS, while a few (11.2%) had severe to extreme CTS.

Rheumatoid arthritis is one of the causes that constantly produce a tenovaginitis and consequently CTS.

Polley and Lipscomb (1966) reported that 100 of a series of 1215 with CTS had coexistent rheumatoid arthritis.

Carpal tunnel syndrome (CTS) in patients with RA was investigated by M. Aluclu, et al[112] who found that out of 40 adult patients (totally eighty hands) with RA, carpal tunnel syndrome was determined in 20 hands (25%) of the patients with RA. They recommend that an electro physiologic examination should be performed in all

patients with RA as a routine diagnostic procedure.

HYPOTHYROIDISM

In our study, hypothyroidism was seen in 7.3% patients with CTS. Most of them had minimal to moderate CTS.

Thyroid diseases such as hypothyroidism and hyperthyroidism can cause CTS. In hypothyroidism, the swelling of the tissue inside the carpal canal causes the syndrome. CTS can be the first sign of hypothyroidism (Golding DN[113]). The substitute medical therapy will improve the clinical symptoms (Fincham RW[114]). In the study by Stevens JC et al[102] 5.2% of patients with CTS had hypothyroidism at the time of presentation

POLYNEUROPATHY

In our study, apart from 4 patients with diabetic poly neuropathy, 6 patients had polyneuropathy for whom a cause was not established. Polyneuropathy was the third common cause of CTS in males (14.3%) in our study. More than 80% patients with polyneuropathy had moderate to severe CTS.

It is common knowledge that the patients with polyneuropathies are more susceptible to nerve compressions (Dawson DM et al [115]). Guillain-Barré also has an association with CTS, but this is not a constant rule (Lambert EH et al[116]). This also holds true for alcohol-induced neuropathies, where the feet are the extremities that are afflicted first and later on the hands. The above studies show polyneuropathies other than diabetes can present with CTS.

PREGNANCY

Out of 3 pregnant females, 1 was a primigravida with pregnancy induced hypertension (PIH) and other 2 were multigravida without any comorbid illness. All the 3 pregnant patients were in their third trimester. Of 3 pregnant women with CTS 1 had bilateral minimal CTS and 2 had bilateral moderate CTS. All the 3 patients did not come after their deliveries for follow up.

According to the studies done by Bahrami MH et al, Sax TW et al, and Finsen V et al, carpal tunnel Syndrome is common in pregnant women [20-23].

Turgut F et al and Mondelli M et al, in their studies found that, CTS is commonly diagnosed during third trimester of pregnancy and it is often bilateral. In the majority of patients symptoms will resolve either spontaneously or will respond to conservative treatment after delivery. [20, 24, 25].

Mondelli et al[117] in their study on CTS in pregnant women found that, CTS in pregnancy is less severe than idiopathic CTS, and has a better spontaneous course.

TRAUMA

In our study, of the 3 patients with trauma, 1 had healed Colles' fracture right wrist and 2 had history of trauma wrists in their symptomatic hands.

CTS can develop as a late onset sequel due to a wrist deformity caused by a carpal bone or radial fracture or other wrist traumas. (Abbott LC) [118.] Altimissi et al [119] reported an incidence of CTS in 31% of patients following a Colles fracture.

SENSITIVITY OF VARIOUS ELECTROPHYSIOLOGICAL STUDIES

In our study, of the various electrophysiological tests done, digit 4 sensory median ulnar comparison study was most sensitive (92.1%) followed by F wave comparison studies (87.2%),and the terminal latency index was least sensitive (54.8%). Digit 2 sensory NCS and median motor NCS had a sensitivity of 79.9% and 60.3% respectively. 2nd lumbrical/interossei had a sensitivity of 64.6%.

This is consistent with the sensitivities of Report of the American Association of Electrodiagnostic Medicine, American Academy of Neurology, and the American Academy of Physical Medicine and Rehabilitation (C K Jablecki et al[120]**),** except that our study showed a greater sensitivity for F wave comparison studies than that of Jablecki et al.

Tests	Present study	C K Jablecki et al
Digit 4 median ulnar	92.1%	85%
Digit 2 sensory	79.9%	65%
Median motor	60.3%	63%
F wave comparison	87.2%	Low sensitivity
Terminal latency index	54.8%	62%
2nd lumbrical/interossei	64.6%	56%

ULTRASONOGRAM BOTH WRISTS

In our study, ultrasonogram showed evidence of increase in cross sectional area of median nerve in 59 of 93 (63.4%) patients with CTS. In addition to median nerve

thickening, it also showed swelling of tendon sheaths in 12 female patients with rheumatoid arthritis.

Shiu Man Wong, et al[121]studied the usefulness of sonography in a prospective cohort of 133 patients with symptoms suggestive of CTS and found in their study that ultrasonogram had a sensitivity of 83%-94% in detecting CTS.

ElMiedany[122] compared the results of US with NCS in a group of patients with CTS against a control group and observed a high degree of correlation between the US findings and NCS in diagnosing and in assessing the severity of CTS.

Sharma M etal from Chandigarh, have studied the role of ultrasonography in diagnosis of carpal tunnel syndrome, and found that there was high degree of correlation between ultrasonography and electrophysiological parameters in patients with CTS.

Sonography measures a different parameter (structural pathologic abnormalities of nerve swelling) from that (physiological malfunctions of the median nerve) measured at an electrodiagnostic study. If sonography yields positive results, CTS is confirmed; if the results are negative, one could then refer the patient for an electrodiagnostic study.

Our study had a lower sensitivity when compared to the above studies, which could be due to the interobserver variability and use of poor resolution ultrasound in earlier part of the study which was rectified later by the use of good resolution ultrasound machine and studies were done by a single radiologist.

SUMMARY

SUMMARY

Salient Features in this study were

- Maximum numbers of patients were in the age group between 40 and 70 years. Females (70.8%) were affected more than males (29.2%). As the duration of symptoms increases there was a progression of severity from mild to extreme CTS.,
- Paresthesias were seen in more than two third (70.8%) of patients. Tinel's sign was positive in nearly one third of males (32.1%) and females (29.2%). Phalen's test was positive in nearly two third of males (64.3%) and females (64.7%).
- 19 out of 41 (46.3%) patients with unilateral symptoms showed subclinical CTS in the other hand also after nerve conduction studies.
- The common causes of carpal tunnel syndrome were idiopathic (44.8%), rheumatoid arthritis (18.8%) diabetes (13.5%) and hypothyroidism (7.3%). Polyneuropathy was the third common cause of CTS in males (14.3%). More than 80% of patients with polyneuropathy had moderate to severe CTS.
- Of the various electrophysiological tests done, digit 4 sensory median ulnar comparison study was most sensitive (92.1%) followed by F wave comparison studies (87.2%),and the terminal latency index(TLI) was least sensitive.
- Ultrasonography had a lower sensitivity in detecting carpal tunnel syndrome.

CONCLUSION

CONCLUSION

- Duration of symptoms with carpal tunnel syndrome correlated very well with the severity in this study.
- Electrophysiological studies identified subclinical carpal tunnel syndrome in asymptomatic hands in three fourths of patients.
- Electrophysiological studies helped to assess the severity of carpal tunnel syndrome which could influence the management.

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PROFORMA

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"Evaluation of Clinical, Electrophysiological, and Radiological Profile of Carpal Tunnel Syndrome"

Institute of Neurology
Madras Medical College, Chennai – 3.

Name: Age/Sex: MIN No:

HISTORY: DURATION:

Paraesthesia - Nocturnal/Diurnal /both
- D1/D2/D3/D4/D5/ Thenar/ Forearm/Arm
- Right/Left

Pain wrists - Right/Left

Sensory loss - D1/D2/D3/D4/D5/ Thenar/ forearm/arm
- Right/ Left

Weakness

Atrophy

Joint swelling

Arthralgia

Pregnancy-Yes /No Amenorrhoea- MA

Cold intolerance

Hoarseness of voice

Neck swelling

Polyuria/polydipsia/polyphagia
PAST HISTORY:
DM/HT/HYPOTHYROIDISM/RA/TRAUMA/TB/RENAL FAILURE

FAMILY HISTORY:

OCCUPATION:
Manual labour/housewife/typist/computer operator/others

PERSONAL HISTORY: smoker/alcoholic/substance abuse

SIGNS:

SENSORY LOSS R  L 

WEAKNESS: LUMBRICALS/OPP/APB/FPB/OTHERS

WASTING:

REFLEX LOSS:

TINEL'S SIGN:

PHALEN'S TEST:

GOITRE

DEFORMITY- SWAN NECK/ BUTTON HOLE/ ULNAR DEVIATION
OTHERS:

INVESTIGATIONS:

	Blood sugar			THYROID(TFT)		
RA fr	F	PP	GTT	T3	T4	TSH

INSTITUTE OF NEUROLOGY
MADRAS MEDICAL COLLEGE, CHENNAI – 3.

"Evaluation of Clinical, Electrophysiological, and Radiological Profile of Carpal Tunnel Syndrome"

NERVE CONDUCTION STUDY

Name: Age/Sex:
MIN No: Unit:

MOTOR NERVE CONDUCTION STUDY

NERVE		LATENCY (m sec)		AMPLITUDE (mV)		NCV (m/s)	F wave latency (m sec)
		Distal	Proximal	Distal	Proximal		
MEDIAN R							
ULNAR R							
MEDIAN L							
ULNAR L							
PALM and WRIST STIMULATION COMPARISON MEDIAN R							
PALM and WRIST STIMULATION COMPARISON MEDIAN L							
2ND LUMBRICAL/ INTEROSSEI R	M						
	U						

2ND LUMBRICAL/ INTEROSSEI L	M						
	U						

TLI MEDIAN R= TLI MEDIAN L=

SENSORY NERVE CONDUCTION STUDY

NERVE		LATENCY (milli sec)	AMPLITUDE (μV)	VELOCITY (m/s)
MEDIAN R (DIGIT 2)				
ULNAR R (DIGIT 5)				
MEDIAN L (DIGIT 2)				
ULNAR R (DIGIT 5)				
DIGIT 4 SENSORY R	M			
	U			
DIGIT 4 SENSORY L	M			
	U			
PALM and WRIST STIMULATION COMPARISON MEDIAN R	M			
	U			
PALM and WRIST STIMULATION COMPARISON MEDIAN L	M			
	U			
	R			
	L			
	R			
	L			

	R			
	L			

EMG STUDIES

MUSCLE	IN	SPON	MUP			RECRUITMENT
			AMP	DUR	PHASES	

ELECTROPHYSIOLOGICAL STAGING

ULTRASONOGRAM BOTH WRISTS

USG wrist	
R	L

CONCLUSION: