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**Original Research Article**

# Evaluation of Nerve Conduction Parameters in Patients with Primary Hypothyroidism: A Cross-Sectional Study in a Tertiary Care Hospital

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**Conflict of interest: Nil**

**Abstract**

**Background:** As neuromuscular dysfunction is associated with hypothyroidism, the nerve conduction parameters are expected to be altered in these patients. Early electrophysiological diagnosis of neuropathy can help clinicians to determine the extent of disease and the course of the treatment. A very few similar studies have been done in eastern India.

**Materials & Methods:** History regarding the duration of the disease, clinical and neurological complaints, and the use of medicines and the level of control of hypothyroidism were recorded on the history record sheet. After history taking, a general clinical examination was done. Then, a neurological examination was conducted with special attention. Neuro-MEP-Micro (version 2009) Machine and its accessories (Manufactured by Neurosoft Medical Diagnostics Limited, Ivanova, Russia). Electrophysiological parameters like nerve conduction study parameters (latency, amplitude, conduction velocity of bilateral median and ulnar motor nerves and median and ulnar sensory nerves) were recorded. Biochemical parameters like T3, T4, and TSH values were recorded from patients' test reports and from Endocrinology OPD prescriptions.

**Results:** The study showed that the mean (±SD) of distal motor latency (DML) of bilateral median motor nerves was significantly increased in cases than that of the control. Mean (±SD) of compound Muscle Action Potential of bilateral median motor nerves was significantly decreased in cases than that of the control. It shows the mean (±SD) of Distal Motor Latency (DML) of bilateral ulnar motor nerves was significantly increased in cases than that of the control. Mean (±SD) of compound muscle action potential of both ulnar motor nerves was significantly decreased in cases than that of the control. MNCV of both-sided median nerves and the ulnar nerves showed a significant decrease in their means as compared to the control. Similarly Distal sensory latency (DSL) of the bilateral median and the Ulnar sensory nerves was significantly increased in cases than in controls. There was a significant decrease in bilateral median and ulnar sensory nerve action potential amplitude (SNAP) in the cases compared to the controls. SNCV of bilateral median and ulnar sensory nerves were significantly reduced in cases as compared to controls. Similarly, the left median SNCV of the cases were significantly ($p$ value $< 0.05$) less than that of the controls.

**Conclusion:** The motor and sensory amplitudes of both-sided median and ulnar nerves were significantly decreased in cases compared to the control. The motor conduction velocity of both-sided median and ulnar nerves and the sensory conduction velocity of the median and ulnar nerves were significantly decreased in cases as compared to controls. There is no significant correlation between nerve conduction study parameters and the duration of the disease in hypothyroid patients.

**Keywords:** Hypothyroidism, Nerve Conduction, Distal Motor Latency (DML), Distal Sensory Latency (DSL), Sensory Nerve Action Potential (SNAP), Compound Muscle Action Potential (CMAP), Motor Nerve Conduction Velocity (MNCV), Sensory Nerve Conduction Velocity (SNCV), Median Nerve, Ulnar Nerve.

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## Introduction

Hypothyroidism is a common endocrinological disorder caused by structural or functional derangements that interfere with thyroid hormone production. This disorder may be classified into primary and secondary categories. Primary hypothyroidism is caused by an intrinsic abnormality in the thyroid gland, while secondary hypothyroidism arises from hypothalamic or pituitary disease [1].

Primary hypothyroidism can occur due to endemic iodine deficiency, autoimmune, or iatrogenic causes. Genetic defects may also interfere with the development of the thyroid gland (e.g. thyroid dysgenesis). Iodine deficiency is responsible for endemic goitre and cretinism, but is a rare cause of adult hypothyroidism unless the iodine intake is very low. Consumption of thiocyanates in cassava or selenium deficiency can lead to hypothyroidism. Not only iodine deficiency but also chronic iodine excess can induce goitre and hypothyroidism.

The prevalence of thyroid disorders depends on various factors such as age, sex, geographical factors, and iodine intake. The prevalence of hypothyroidism in India is 10.95%, affecting approximately one in 10 adults[3]. Among all cities, the highest prevalence of hypothyroidism was recorded in Kolkata (21.67%), while other cities showed comparable rates, like 8.88% in Hyderabad to 11.07% in Delhi [2].

A common presenting complaint of hypothyroidism is Peripheral neuropathy, which is a progressive nerve disorder, and it becomes a chronic disability if left untreated. Patients develop the usual manifestations of peripheral neuropathy, like painful paraesthesia, numbness of limbs, decreased sensations of vibration, joint-position, and touch-pressure. The muscle contraction and relaxation are slowed down while the duration is prolonged. Loss of reflexes, weakness of proximal muscles are some other common features of hypothyroidism [3].

Hypothyroidism leads to demyelination due to oxidative damage of the myelin membrane, resulting in diminished nerve conduction velocity [1, 3]. There is also increased deposition of adipose and mucinous tissue in the peripheral nerves, leading to compression of the nerves [3].

A study by Shirabe et al., however, suggested that myxoedema causes not only compressive neuropathy but also metabolic disorder of Schwann cells, which results in segmental demyelination and turns into an intrinsic polyneuropathy [4]. Involvement of sensory nerves may be due to axonal degeneration. It has been identified that sensory nerves are affected earlier than motor. Though the reason for the involvement of the sensory nerve earlier than the motor is yet to be known [5]. The severity of peripheral neuropathy correlates with the degree and duration of hormonal deficiency in hypothyroidism patients[6]. Prevalence of neuromuscular disorders related to thyroid dysfunction has been found to be about 20-80% in previous studies [5,6]. A previous study by AG Unnikrishnan et al [2]. showed that the prevalence of undetected hypothyroidism was almost one-third of their study population, and hypothyroid patients were diagnosed for the first time during the study-related screening. This indicates that even as it continues to impair an individual's daily quality of life, work performance, and economic productivity, a considerable proportion of patients do not seek medical attention until the problems are severe enough. Illiteracy and low socioeconomic status could be the reasons for their ignorance regarding the consequences and the complications of delayed or irregular treatment. So, a large portion of hypothyroid cases may go undetected and untreated [2].

Nerve conduction studies have an important role in the evaluation of peripheral neuropathies by confirming the clinical suspicion of neuropathy. It can identify the predominant pathophysiology, such as axonal or demyelinating, sensory or motor and also the temporal course of the disease, i.e. acute, subacute or chronic. Electrodiagnostic studies can provide an objective and quantitative measure of nerve function and also help in predicting the prognosis of neuropathy. Latent subclinical neuropathy in hypothyroidism can also be investigated using an electrophysiological study [7].

As neuromuscular dysfunction is associated with hypothyroidism, the nerve conduction parameters are expected to be altered in these patients. Early electrophysiological diagnosis of neuropathy can help clinicians to determine the extent of disease and the course of the treatment. A very few similar studies have been done in eastern India. On this background, we conducted our study.

**Materials and Methods**

The observational cross-sectional, case-control study was conducted at the Department of Physiology, R.G. Kar Medical College, in collaboration with the Department of Endocrinology, R.G. Kar Medical College & Hospital. Clinical cases of primary hypothyroidism (between 20-60 years of age, both Male and Female), diagnosed and referred from the Endocrinology OPD, R.G Kar Medical College and Hospital, Kolkata, were included in the study. Approval from the Institutional Ethics Committee was obtained before commencement of the study.

**Criteria for diagnosing primary hypothyroidism:** A normal TSH level excludes primary hypothyroidism. If the TSH is elevated, an unbound T4 level is needed to confirm the presence of clinical hypothyroidism, but T4 is inferior to TSH when used as a screening test, because it will not detect subclinical hypothyroidism. Circulating unbound T3 levels are normal in about 25% of patients, reflecting adaptive deiodinase responses to hypothyroidism. T3 measurements are, therefore, not indicated. Once clinical or subclinical hypothyroidism is confirmed, the etiology is usually easily established by demonstrating the presence of TPO antibodies [8].

**Inclusion criteria & exclusion criteria of cases:** Clinical cases of primary hypothyroidism aged between 20 and 60 years, irrespective of gender and duration of disease and referred from the Endocrinology Department of R.G Kar Medical College, Kolkata, were considered for the study. Sixty apparently healthy controls were taken. Study subjects were selected as per the following inclusion and exclusion criteria.

**Exclusion criteria**

- Diabetes Mellitus
- Secondary hypothyroidism
- Alcoholism
- Neuromuscular Disorder
- Leprosy
- Drug-Induced/Toxic Neuropathy
- Family H/o Neuropathy
- Malignancy
- HIV
- Liver diseases
- Kidney Disease
- Myopathy
- Pregnancy
- Patients with permanent pacemaker implants
- Patients unwilling to participate in the study

**Inclusion criteria**

- Primary hypothyroidism
- Aged between 20-60 years
- Males and females
- Diagnosed in the department of Endocrinology, RGKMC&H
- Patients willing to participate in the study

**Sample size:** One hundred (100)

Sample size is calculated using the formula:

$n = (Z\alpha/2)2\ pq / d^2$

Prevalence of NCS confirmed Neuropathy ranges between 20 – 80%. [6, 9] So, in this study, p has been taken to be 50%. Margin of error (d) has been taken to be 10%. Therefore $n = [(1.96)2*0.5*(1-0.5)]/(0.1)^2= 96.04 \sim 96$ (rounded off to 100) where

$Z\alpha/2 = 1.96$, $p = 0.5$, $q =(1-p) = 0.5$, and $d = 0.1$

History regarding the duration of the disease, clinical and neurological complaints, use of medicines and level of control of hypothyroidism was recorded in the history record sheet. After history taking, a general clinical examination was done. Then, a neurological examination was conducted with special attention. Neuro-MEP-Micro (version 2009) Machine and its accessories (Manufactured by Neurosoft Medical Diagnostics Limited, Ivanova, Russia)

**Study variables, laboratory investigations, parameters:** Electrophysiological parameters: Nerve conduction study parameters (Latency, Amplitude, Conduction Velocity of bilateral median and Ulnar Motor nerves and median and Ulnar Sensory nerves.

Biochemical parameters: T3, T4, and TSH values were recorded from patients' test reports and from Endocrinology OPD prescriptions.

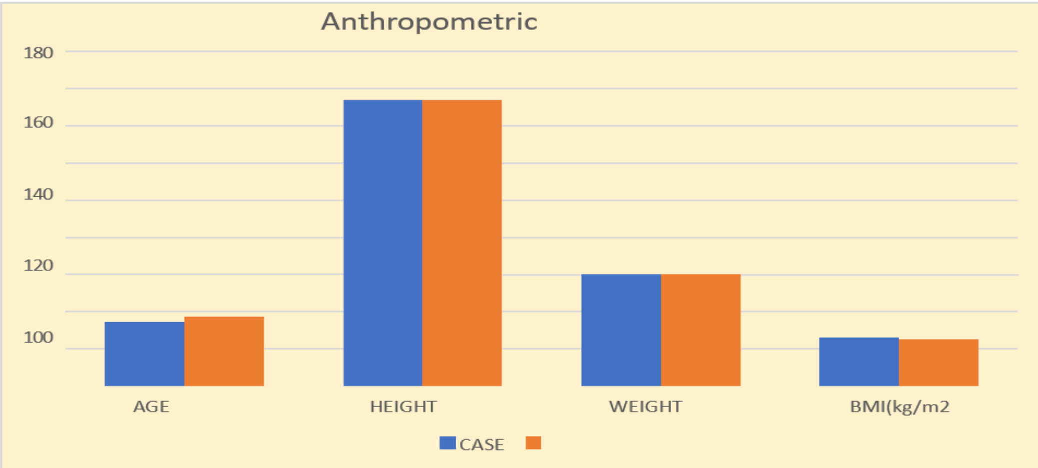
The subjects were placed in a supine position at a temperature of 22-24ºC in the Neurophysiology Laboratory of the Department of Physiology, and the procedures were explained. A nerve conduction study was performed by three electrodes: Recording electrodes, a Reference electrode, and a ground electrode. The electrodes (disposable adhesive surface electrode) were placed after cleaning the skin with Neuro-Prep gel to reduce the skin impedance. A nerve conduction study was performed by using the Neuro-MEP-Micro (version 2009) Machine. Nerve conduction study parameters of both the median and ulnar nerves were recorded in the study. The latency, amplitude, and velocity of motor and sensory conduction were recorded. Distal Motor Latency (DML), Distal Sensory Latency (DSL), Sensory Nerve Action Potential (SNAP), Compound muscle action potential (CMAP), Motor nerve conduction velocity (MNCV) and Sensory nerve conduction velocity (SNCV) were evaluated by Belly Tendon montage and antidromic stimulation, respectively.

**Motor Nerve Conduction Study:** Motor NCS was performed by electrical stimulation of a peripheral nerve and recording from a muscle supplied by this nerve, characterised by its latency, amplitude, and conduction velocity. Latency in milliseconds (Ms) is the time from the onset of stimulus to the point of take-off from baseline. It is an index of the speed of impulse travel. The size of the response, called amplitude (in mV), is measured from the baseline to the top of the motor response. Conduction velocity (in M/s) reflects the fastest motor axons.

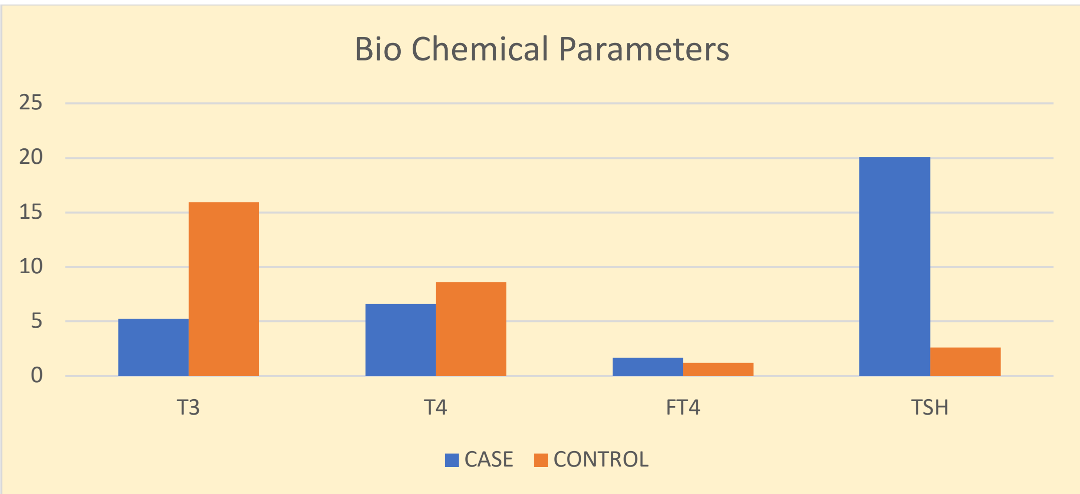
CV (M/s)=Distance (mm)/Proximal Latency–Distal Latency (ms)

**Results**

Bar diagram 1 shows that there was no statistically significant difference between control and cases of hypothyroidism with respect to age and other anthropometric parameters like height, weight, Body Mass Index (BMI) and Waist circumference to Hip circumference ratio (WHR) (Bar diagram 1). The study shows the gender distribution of study subjects. Among the study subjects, 8% were male.




**Bar Diagram 1: Anthropometric parameters of study participants**




**Bar Diagram 1: Showing Biochemical Parameters of the Study Subjects**

Bar diagram 2 shows that the mean (±SD) of serum T3 was significantly less in cases (5.27±4.83) than that of the control (15.93±26.63), whereas the mean (±SD) of TSH was significantly increased in cases (20.09±28.16) than that of the control (2.62±0.93). Similarly, there was a significant increase in the mean (±SD) of serum FT4 levels in cases (1.66±1.740) as compared to control subjects (1.22±0.37), as shown in Table 2. The bar diagram (2) depicts the same.

**Table 1: Comparison of nerve conduction study parameters of both median motor nerves between the cases and controls**

| Median Motor | | Group | N | Mean | Std. Deviation | Std. Error Mean | P- Value |
|---|---|---|---|---|---|---|---|
| DSL (ms) | Right | Control | 60 | 2.78 | 0.25 | 0.03 | 0.0001 |
| | | Case | 100 | 4.06 | 0.93 | 0.09 | |
| | Left | Control | 60 | 2.92 | 0.30 | 0.04 | 0.0001 |
| | | Case | 100 | 3.81 | 0.78 | 0.08 | |
| CMAP (μV) | Right | Control | 60 | 7.26 | 0.83 | 0.11 | 0.0001 |
| | | Case | 100 | 8.21 | 1.74 | 0.17 | |
| | Left | Control | 60 | 7.37 | 0.75 | 0.10 | 0.0005 |
| | | Case | 100 | 7.87 | 0.93 | 0.09 | |
| MNCV (m/s) | Right | Control | 60 | 59.33 | 2.30 | 0.30 | 0.0001 |
| | | Case | 100 | 51.70 | 5.21 | 0.52 | |
| | Left | Control | 60 | 59.08 | 2.26 | 0.29 | 0.0001 |
| | | Case | 100 | 52.52 | 3.11 | 0.31 | |

**$p < 0.05$ was considered the level of significance ($p < 0.05$).**

Table 1 shows the comparison of median nerve DML, CMAP and MNCV parameters between cases and controls. In this study, the mean (±SD) of Distal Motor Latency (DML) of right median motor nerves was significantly increased (p value <0.05) in cases (4.06±0.93) than that of the controls (2.78±0.25).

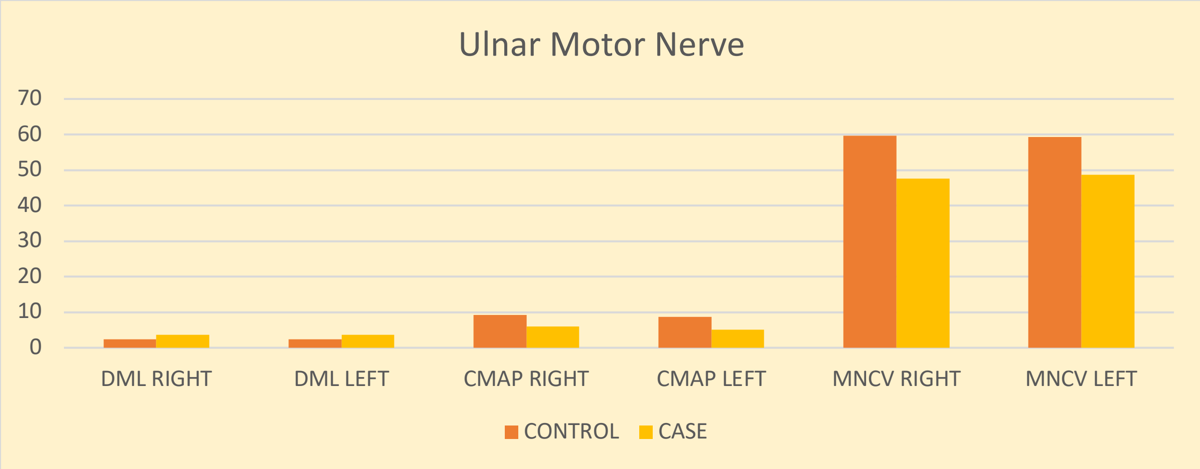
The DML of left median nerves were also increased in cases (3.81±0.78) than in controls (2.92±0.3). Mean (±SD) of compound muscle action potential of right median motor nerves was significantly decreased in cases (8.21 ±1.78) than that of the controls (7.26±0.83). The left median nerve CMAP (7.87±0.93) was also decreased significantly compared to that of the controls (7.37±0.75).

MNCV of right and left median nerves were significantly decreased in cases (51.7±5.21 and 52.52±3.11, respectively) as compared to those of the controls (59.33±2.3 and 59.08±2.26, respectively). The abnormalities in DML, CMAP and MNCV of bilateral median nerves in comparison to control have been shown in the bar diagram 3 also.

**Table 2: Comparison of nerve conduction parameters of both ulnar motor nerves in hypothyroid patients and controls**

| Ulnar Motor | | Group | N | Mean | Std. Deviation | Std. Error Mean | P- Value |
|---|---|---|---|---|---|---|---|
| DML (ms) | Right | Control | 60 | 2.45 | 0.18 | 0.02 | 0.0001 |
| | | Case | 100 | 3.71 | 0.41 | 0.04 | |
| | Left | Control | 60 | 2.46 | 0.19 | 0.02 | 0.0001 |
| | | Case | 100 | 3.63 | 0.4 | 0.04 | |
| CMAP (μV) | Right | Control | 60 | 9.16 | 1.01 | 0.13 | 0.0001 |
| | | Case | 100 | 6.01 | 1.82 | 0.18 | |
| | Left | Control | 60 | 8.65 | 1.23 | 0.16 | 0.0001 |
| | | Case | 100 | 5 | 1.52 | 0.15 | |
| MNCV (m/s) | Right | Control | 60 | 59.61 | 2.78 | 0.36 | 0.0001 |
| | | Case | 100 | 47.63 | 7.6 | 0.76 | |
| | Left | Control | 60 | 59.28 | 2.46 | 0.32 | 0.0001 |
| | | Case | 100 | 48.7 | 7.15 | 0.72 | |

**$p < 0.05$ was considered the level of significance ($p < 0.05$).**



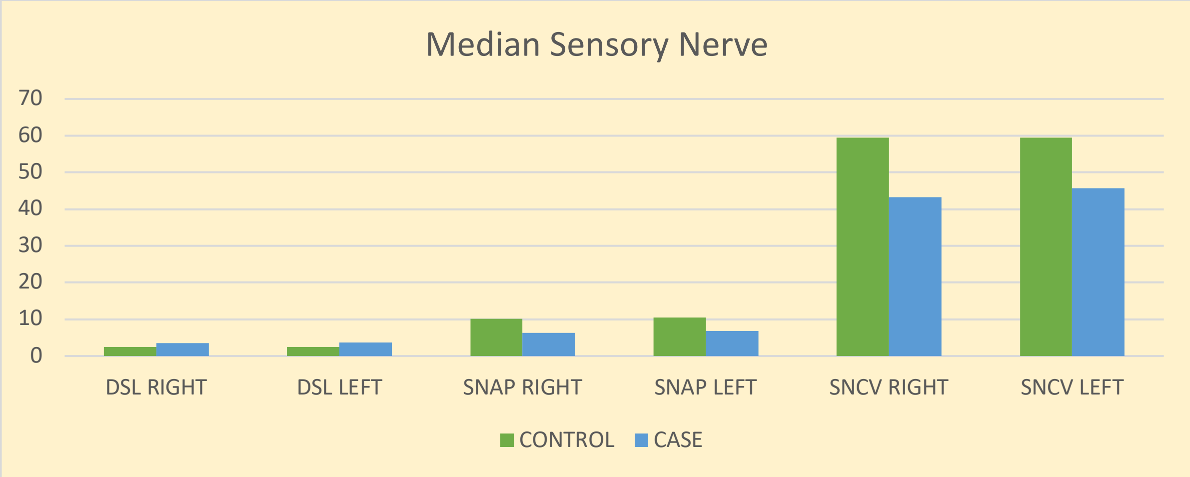

**Bar Diagram 3: Showing changes in ulnar motor nerve conduction parameters among study subjects**

Table 2 shows the mean (±SD) of Distal Motor Latency (DML) of right ulnar motor nerves, which were significantly (p value<0.05) increased in cases (3.71±0.41) than that of the control (2.45±0.18). Significant increase in left-sided ulnar nerve DML were noted among the cases (3.63±0.4) than that of the controls (2.46±0.19). Mean (±SD) of compound muscle action potential of right ulnar motor nerves (6.01 ±1.82) was significantly decreased in cases than that of the control (9.16 ±1.01). CMAP of left ulnar nerves of the cases (5±1.52) also showed a significant decrease in their means than that of the controls (8.65±1.23). MNCV of right ulnar nerves of cases (47.63±7.6) showed a significant decrease in their means as compared to control (59.61±2.78). Significant decrease was also seen in MNCV of the left ulnar nerves in cases (48.7±7.15) than that of the controls (59.28±2.46). The abnormalities in DML, CMAP and MNCV of bilateral ulnar nerves in comparison to control have been shown in the bar diagram 4 also.

**Table 3: Comparison of nerve conduction parameters of both median sensory nerves of hypothyroid patients with controls**

| Median Sensory | | Group | N | Mean | Std. Deviation | Std. Error Mean | P- Value |
|---|---|---|---|---|---|---|---|
| DSL (ms) | Right | Control | 60 | 2.45 | 0.30 | 0.04 | 0.0001 |
| | | Case | 100 | 3.54 | 0.64 | 0.06 | |
| | Left | Control | 60 | 2.44 | 0.29 | 0.04 | 0.0001 |
| | | Case | 100 | 3.68 | 0.75 | 0.08 | |
| SNAP (µV) | Right | Control | 60 | 10.12 | 1.04 | 0.13 | 0.0001 |
| | | Case | 100 | 6.34 | 1.81 | 0.18 | |
| | Left | Control | 60 | 10.55 | 1.15 | 0.15 | 0.0001 |
| | | Case | 100 | 6.79 | 1.51 | 0.15 | |
| SNCV (m/s) | Right | Control | 60 | 59.44 | 2.48 | 0.32 | 0.0001 |
| | | Case | 100 | 43.26 | 8.58 | 0.86 | |
| | Left | Control | 60 | 59.53 | 2.09 | 0.27 | 0.0001 |
| | | Case | 100 | 45.74 | 8.26 | 0.83 | |

**p < 0.05 was considered the level of significance (p < 0.05).**




**Bar Diagram 4: Showing changes in median sensory nerve conduction parameters among study subjects**

Table 3 shows that the mean (±SD) of distal sensory latency (DSL) of right median sensory nerves was significantly increased in cases (3.54±0.64) than that of the controls (2.45±0.3), while DSL of the left median nerves of the cases (3.68 ±0.75) also showed a significant increase in their means than that of the controls (2.44 ±0.29).

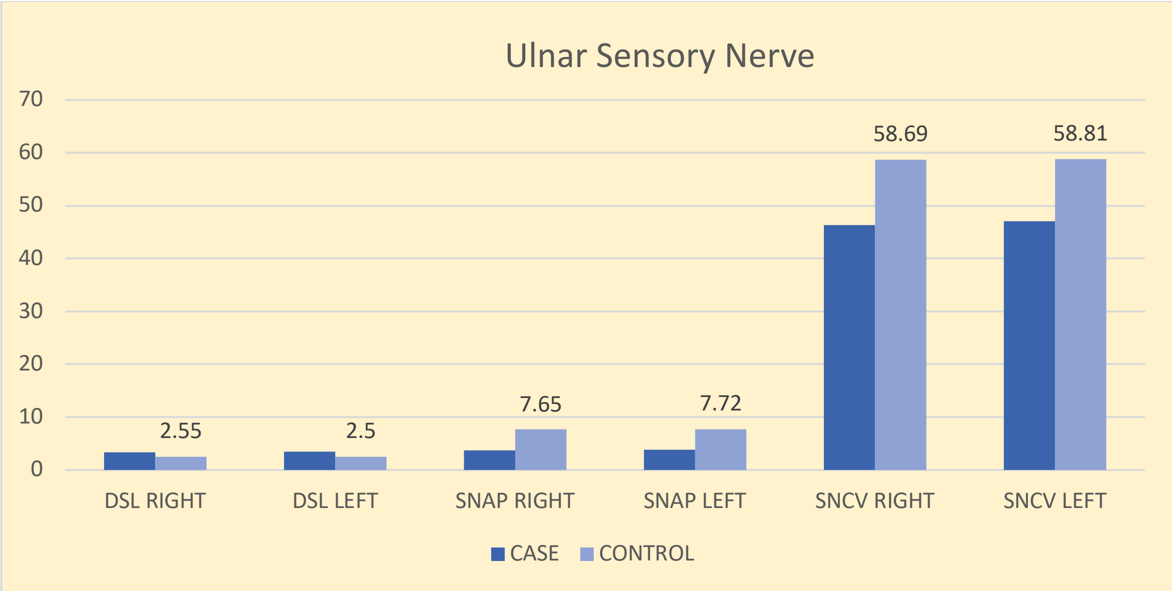
There was a significant decrease in right median sensory nerve action potential amplitude (SNAP) of the cases (6.34±1.81) than that of the controls (10.12 ±1.04). Left median SNAP of the cases (6.79±1.51) was also decreased significantly compared to that of the controls (10.55±1.15).

SNCV of right median sensory nerves were significantly reduced in cases (43.26±8.58) as compared to controls (59.44± 2.48). Similarly, the left median SNCV of the cases (45.74±8.26) were significantly (p value < 0.05) less than that of the controls (59.53± 2.09). The abnormalities in DML, CMAP and MNCV of bilateral median sensory nerves in comparison to the control have been shown in the bar diagram 5 also.

**Table 4: Comparison of nerve conduction parameters of bilateral ulnar sensory nerves of hypothyroid patients with controls**

| Ulnar Sensory | | Group | N | Mean | Std. Deviation | Std. Error Mean | P- Value |
|---|---|---|---|---|---|---|---|
| DSL (ms) | Right | Control | 60 | 2.55 | 0.21 | 0.03 | 0.0001 |
| | | Case | 100 | 3.39 | 0.42 | 0.04 | |
| | Left | Control | 60 | 2.5 | 0.19 | 0.02 | 0.0001 |
| | | Case | 100 | 3.48 | 0.57 | 0.06 | |
| SNAP (µV) | Right | Control | 60 | 7.65 | 0.48 | 0.06 | 0.0001 |
| | | Case | 100 | 3.71 | 0.85 | 0.08 | |
| | Left | Control | 60 | 7.72 | 0.42 | 0.05 | 0.0001 |
| | | Case | 100 | 3.79 | 1.06 | 0.11 | |
| SNCV (m/s) | Right | Control | 60 | 58.69 | 2.48 | 0.32 | 0.0001 |
| | | Case | 100 | 46.36 | 5.22 | 0.52 | |
| | Left | Control | 60 | 58.81 | 2.24 | 0.29 | 0.0001 |
| | | Case | 100 | 47.01 | 5.72 | 0.57 | |

**p < 0.05 was considered the level of significance (p < 0.05).**




**Bar Diagram 5: Showing changes in ulnar sensory nerve conduction parameters among study subjects**

Table 4 shows that the mean (±SD) of distal sensory latency (DSL) of right ulnar sensory nerves was significantly increased in cases (3.39± 0.42) than that of the controls (2.55±0.21). Significant increase in DSL of left ulnar sensory nerves of the cases (3.48 ±0.57) was noted compared to that of the control (2.5±0.19).

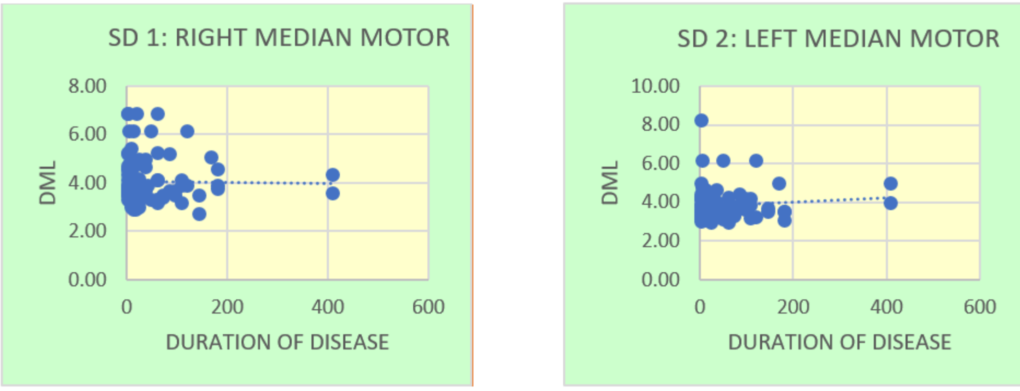
The right ulnar SNAP were significantly less in cases (3.71±0.85) than that of the control (7.65 ±0.48). SNCV of right ulnar sensory nerves were significantly reduced in cases (46.36±5.22) as compared to controls (58.69±2.48). The left ulnar SNAP were significantly less in cases (3.79±1.06) than that of the control (7.72±0.42). SNCV of the left Ulnar

Sensory nerves were significantly reduced in cases (47.01±5.72) as compared to controls (58.81±2.24). The abnormalities in DML, CMAP and MNCV of bilateral ulnar sensory nerves in comparison to control have been shown in the bar diagram 6 also.

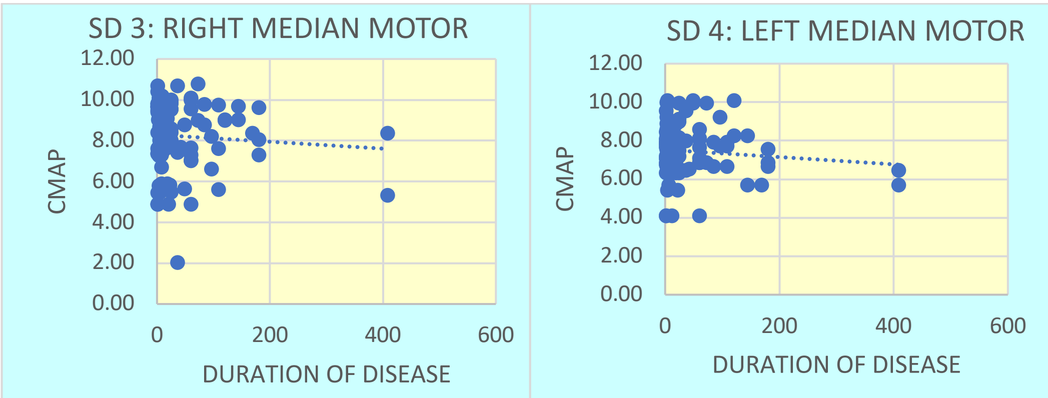
**Table 5: Showing the relation between median motor NCS parameters and duration of disease**

| Median Motor | | Pearson Correlation Coefficient (R) | P-Value |
|---|---|---|---|
| DML (ms) | Right | -0.016 | 0.874 |
| | Left | 0.099 | 0.326 |
| CMAP (µV) | Right | -0.068 | 0.503 |
| | Left | -0.098 | 0.333 |
| MNCV (m/s) | Right | -0.09 | 0.375 |
| | Left | -0.015 | 0.884 |

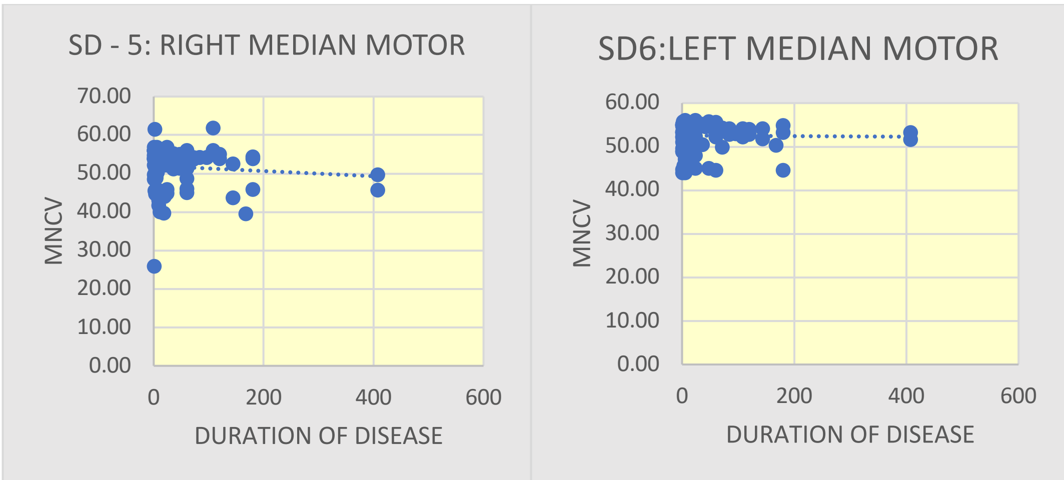
Table 5 shows DML of the right median nerve decreases (r = -0.016, p=0.874) while DML of the left median nerve increases (r = 0.099, p= 0.326) with an increase in duration of disease, but these changes are not significant. CMAP of the right (r=-0.068, p=0.503) and left (r=-0.098, p=0.333) median nerve also shows no significant correlation with duration of disease. MNCV of both median nerves shows negative correlation with duration of disease, but these changes are not significant [(right MNCV r=-0.09, p=0.375) (left MNCV r=-0.015, p=0.884)]. Scattered diagrams 1-6 show the same findings.




**Scattered Diagram – 1 and 2: Showing the relation between the distal motor latency of the bilateral median motor nerve with duration of disease.**




**Scattered Diagram– 3 and 4: Showing the relation between the compound muscle action potential of the bilateral median motor nerve with duration of disease.**




**Scattered Diagram– 5 and 6: Showing the relation between motor nerve conduction velocities of the bilateral median motor nerve and duration of disease.**

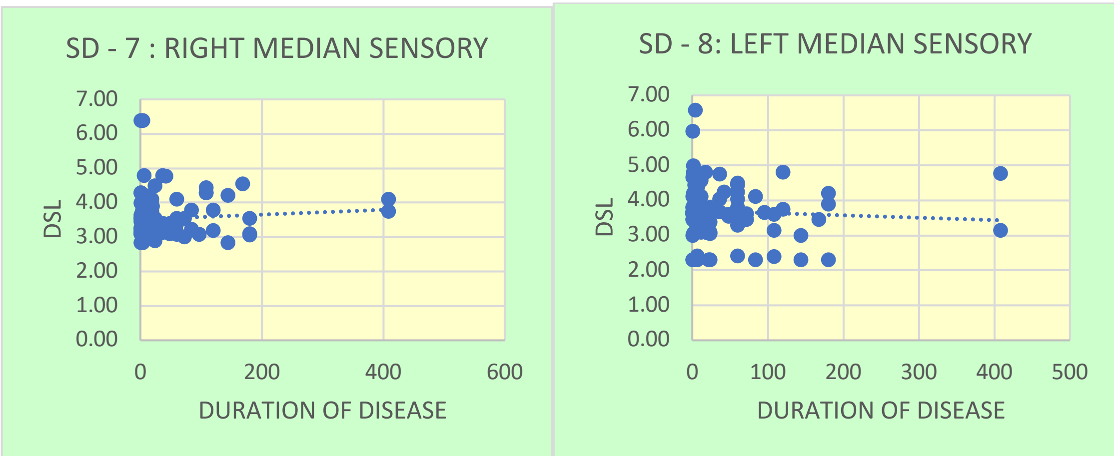
**Table 6: Showing the relation between median sensory NCS parameters and duration of disease**

| Median Sensory Parameter | | Pearson Correlation Coefficient (R) | P-Value |
|---|---|---|---|
| DSL(ms) | Right | 0.076 | 0.45 |
| | Left | -0.063 | 0.534 |
| SNAP(µV) | Right | 0.028 | 0.783 |
| | Left | -0.003 | 0.976 |
| SNCV(m/s) | Right | -0.194 | 0.054 |
| | Left | -0.161 | 0.11 |

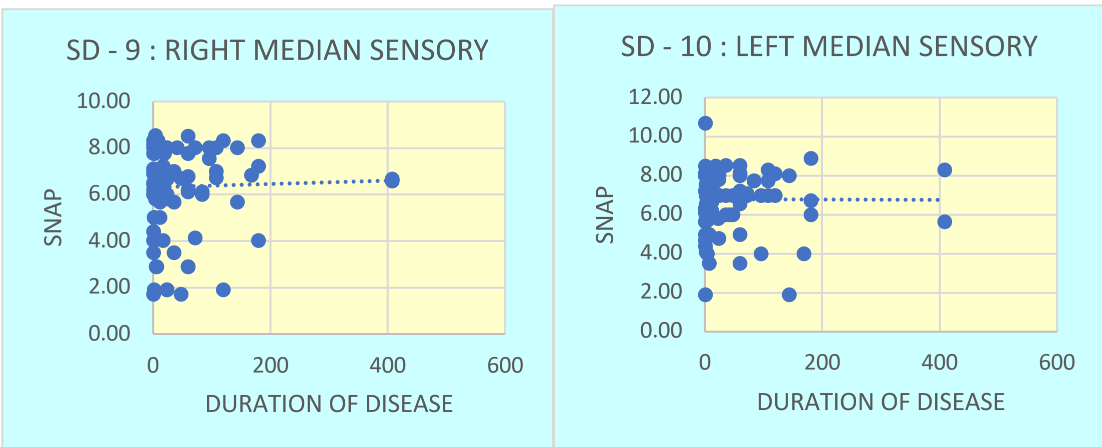
Table 6 shows a positive correlation between DSL of the right median sensory nerve with duration of disease (r=0.076, p=0.45) and a negative correlation between left median sensory nerve with duration of disease (r=-0.063, p=0.534), though these changes are not significant.

SNAP of right median sensory increases (r=0.028, p=0.783) and SNAP of left median sensory decreases (r=-0.003, p=0.976) with an increase in duration of disease.

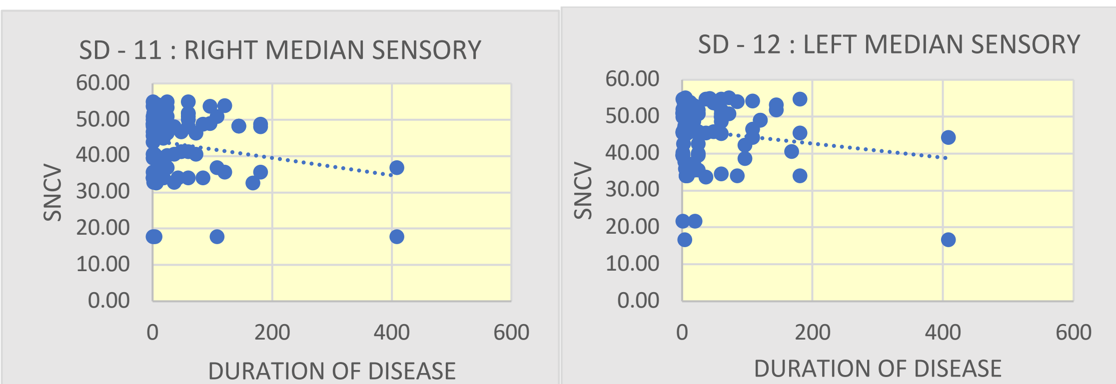
These changes are not great. SNCV of both the median sensory nerves show negative correlation (r=-0.194, p=0.054 and r= -0.161, p= 0.11 of right and left side, respectively) with duration of disease, which are not significant. Scattered diagrams 7-12 show similar findings.




**Scattered Diagram – 7 and 8: Showing the relation between the distal sensory latency of the bilateral median sensory nerve with duration of disease.**




**Scattered Diagram – 9 and 10: Showing the relation between the sensory nerve action potential of the bilateral median sensory nerve with duration of disease.**

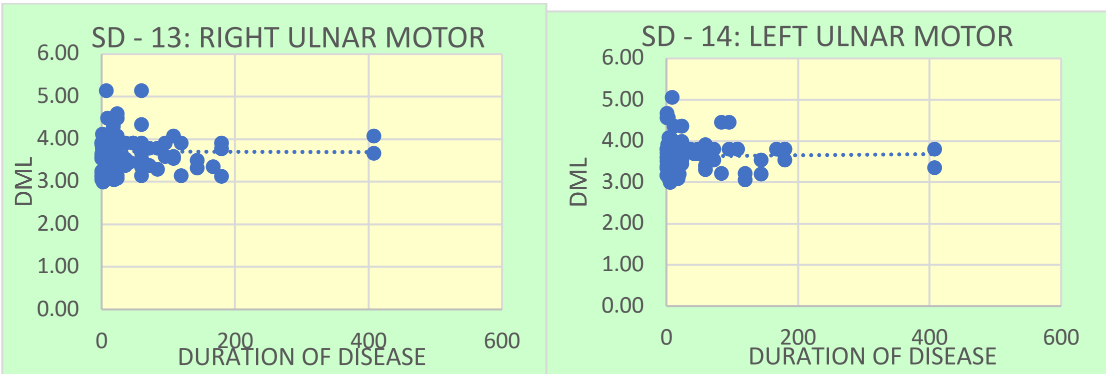



**Scattered Diagram –11 and 12: Showing the relation between the sensory nerve conduction velocities of the bilateral median sensory nerve with duration of disease.**

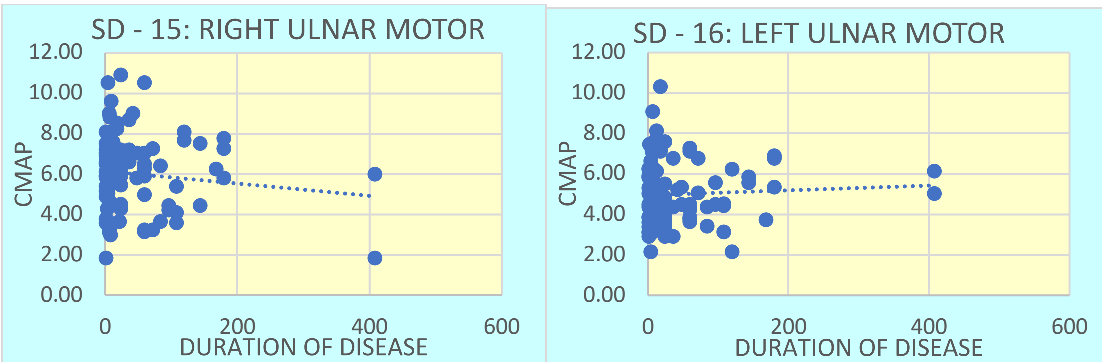
**Table 7: Showing the relation between ulnar motor NCS parameters and duration of disease**

| Ulnar Motor Parameter | | Pearson Correlation Coefficient (R) | P-Value |
|---|---|---|---|
| DML (ms) | Right | -0.005 | 0.96 |
| | Left | 0.045 | 0.657 |
| CMAP (µV) | Right | -0.116 | 0.2505 |
| | Left | 0.054 | 0.595 |
| MNCV(m/s) | Right | 0.026 | 0.799 |
| | Left | -0.193 | 0.055 |

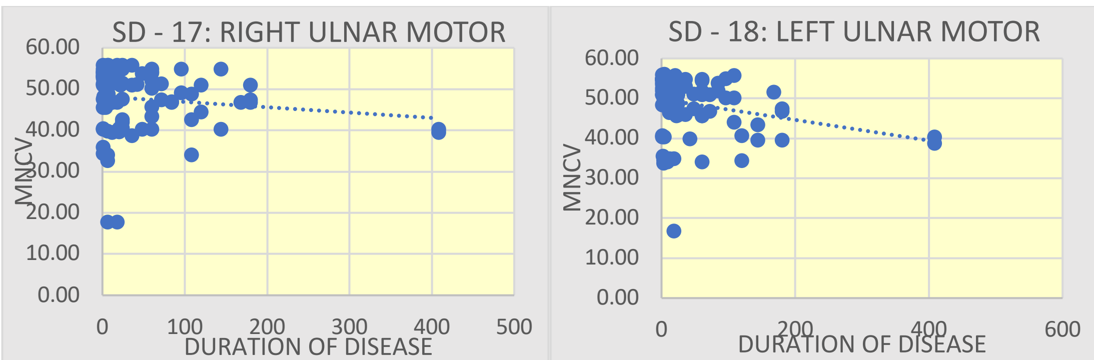
Table 7 shows that there is a negative correlation between DML of the right ulnar motor nerve with duration of disease, but it is not significant (r= -0.005, p= 0.96). There is a positive but no significant relation between DML of the left ulnar motor nerve with duration of disease (r= 0.045, p= 0.657). There are no significant relations between the CMAP of both the ulnar motor nerves and the duration of disease. MNCV of the right ulnar motor nerve increases while the left ulnar nerve decreases with an increase in duration of disease. These findings are visible in scattered diagrams 13-18.




**Scattered Diagram – 13 and 14: Showing** the **relation between the distal motor latency of the bilateral ulnar motor nerve with duration of disease.**




**Scatter Diagram – 15 and 16: Showing the relation between the compound muscle action potential of the bilateral ulnar motor nerve with duration of disease.**




**Scattered Diagram – 17 and 18: Showing the relation between the motor nerve conduction velocity of the bilateral ulnar motor nerve with duration of disease.**

**Table 8: Showing the relation between ulnar sensory NCS parameters and duration of disease**

| Ulnar Sensory Parameter | | Pearson Correlation Coefficient (R) | P-Value |
|---|---|---|---|
| DSL (ms) | Right | 0.054 | 0.596 |
| | Left | -0.026 | 0.795 |
| SNAP (µV) | Right | 0.05 | 0.625 |
| | Left | 0.042 | 0.677 |
| SNCV(m/s) | Right | -0.048 | 0.639 |
| | Left | 0.117 | 0.246 |

Table 8 shows that there is a positive correlation between DSL of the right ulnar sensory nerve with duration of disease (r=0.054, p=0.596), but it is not significant. DSL of the left ulnar sensory nerve shows a negative correlation with duration of disease (r=-0.026, p=0.795), but it is not significant. SNAP of bilateral ulnar sensory nerves increase with an increase in duration of disease, but it is not significant. SNCV of the right ulnar sensory nerve shows negative, while SNCV of the left ulnar sensory nerve shows positive correlation with duration of disease. Both findings are significant.

**Discussion**

In the present study, we evaluated the clinical, biochemical and electro-physiological findings in diagnosed hypothyroid patients. In the study period, 100 cases fulfilled the inclusion and exclusion criteria and participated in the study. Sixty subjects were taken as controls. We performed the nerve conduction study on the subjects in the neurophysiology laboratory of R.G. Kar Medical College and Hospital under suitable temperature and other conditions.

Our study showed there was no statistically significant difference between control and cases of hypothyroidism with respect to age and other anthropometric parameters (Table 1). Mean ±SD of the age and height was 37.15±10.13 (yrs.) and 153.85±6.02 (cm) in comparison to 34.77 ± 10.61(yrs.) and 153.73±6.39(cm) in controls, showing a non-significant association (p>0.05). Our study also showed that the mean (±SD) of serum T3 was significantly less in cases (5.27±4.83) than that of the control (15.93±26.63), whereas the mean (±SD) of TSH was significantly increased in cases (20.09±28.16) than that of the control (2.62±0.93). Similarly, there was a significant increase in the mean (±SD) of serum FT4 levels in cases (1.66±1.740) as compared to control subjects (1.22±0.37). A study by Ruchika Garg et al [10] showed similar findings.

**Median Motor:** Satish et al [11] showed that distal motor latencies (DML) were significantly prolonged, and CMAP amplitude and CV were found to be significantly reduced in cases as compared to controls in bilateral motor median nerves (p <0.05). Another study by Rao SN et al [12] showed similar findings in their study. They found abnormal nerve conduction study in hypothyroid patients predominantly affecting the median nerves. They also reported significantly prolonged motor latencies. Our study also showed that the mean (±SD) of Distal Motor Latency (DML) of bilateral median motor nerves was significantly increased in cases than that of the control. Mean (±SD) of compound muscle action potential of bilateral median motor nerves was significantly decreased in cases than that of the control (Table 4). Results agreed with the results of other researchers [5, 13-15].

Schutt et al.[16] showed a decreased motor nerve conduction velocity. A study by Mahadule et al [17] revealed that distal motor latencies were prolonged, CMAP amplitudes reduced, and MNCV slowed in the peripheral nerves. In hypothyroidism, conduction velocity and amplitude are decreased as per the study by Lai et al [18].

**Ulnar Motor:** Our study shows the mean (±SD) of Distal Motor Latency (DML) of bilateral ulnar motor nerves was significantly increased in cases than that of the control. Mean (±SD) of the compound muscle action potential of both ulnar motor nerves was significantly decreased in cases than that of the control. MNCV of both-sided ulnar nerves showed a significant decrease in their means as compared to the control. A study by Ruchika Garg et al [10], however, showed that the Ulnar nerve parameters (distal motor and sensory latencies, motor and sensory amplitudes and nerve conduction velocities) were found to be normal in hypothyroid patients as compared with controls. A study by Ajeena Ihsan M et al [14] also does not corroborate our findings, but a study by Nemni et al [19] agrees with our findings.

**Median Sensory:** Our study showed the mean (±SD) of distal sensory latency (DSL) of bilateral median sensory nerves was significantly increased in cases than in controls. The sensory nerve action potential amplitude (SNAP) and conduction velocity (SNCV) were significantly reduced in cases as compared to controls. A study by Ruchika Garg et al [10] also showed that DSL of the median nerve was significantly prolonged. Our findings are also consistent with other studies, and the SNAP and sensory conduction velocity (SNCV) of the median nerve in hypothyroid patients were highly significantly decreased, findings almost similar to those of other studies [10, 15, 20, 21]. In sensory parameters, DSL of the median nerve was significantly prolonged.

**Ulnar Sensory Nerve:** Our study shows the mean (±SD) of distal sensory latency (DSL) of bilateral ulnar sensory nerves was significantly increased in cases than in controls. The ulnar sensory nerve action potential amplitude (SNAP) and conduction velocity (SNCV) were significantly reduced in cases as compared to controls. The abnormalities in DSL, SNAP and SNCV of bilateral ulnar sensory nerves in comparison to the control have been shown in the bar diagram 5 also. As per Ruchika Garg et al[10], ulnar sensory nerve parameters were found to be normal in hypothyroid patients as compared with controls. The results agreed with other studies but varied from the study of Nemni et al[19].

## Conclusion

Motor and sensory distal latencies of both-sided median and ulnar nerves on both sides were significantly increased in cases than in controls. The motor and sensory amplitudes of both-sided median and ulnar nerves on both sides were significantly decreased in cases compared to those of the control. However, motor conduction velocity of both the median and ulnar nerves and sensory conduction velocity of the median and ulnar nerves were significantly decreased in cases as compared to control.

There is no significant correlation between nerve conduction study parameters and the duration of the disease in hypothyroid patients.

We found that CMAP, SNAP and MNCV, SNCV were significantly decreased and distal motor and sensory latencies were significantly increased in cases than controls, which indicate mixed type of polyneuropathy, both axonal and demyelinating in hypothyroid patients.

Therefore, we can conclude that Peripheral neuropathy in hypothyroidism due to axonal loss and/or demyelination can be evaluated effectively by nerve conduction studies. So, the hypothyroid patients should be routinely screened by the Nerve Conduction Study.

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