

THE RELATIONSHIP BETWEEN NERVE CONDUCTION STUDY AND LONG WORKING HOURS IN COMPUTER WORKERS.

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Background: Increase of computer work coincided with a decreased nerve conduction velocities of peripheral nerves (median and ulnar). **Objective:** Aim of study is to measure the abnormality of nerve conduction entrapment of the median and ulnar nerves in the mouse-operating limb. **Material and Methods:** Nerve conduction study was performed on 60 computer operators: group I, with 30 right handed office workers who worked at a computer for minimum of 6 - 8 hours per day in the college; and group II, with 30 right handed individuals who worked at computer for < 2 hours/ week. **Results:** We observed decreased conduction velocity in median and ulnar nerve of both motor and sensory division in computer operators working for 6-8 hours/day. **Conclusion:** NCV is a simple, reliable, and sensitive tool to measure and describe nerve conduction entrapment abnormality.

Key Words: computer operators, mouse-operating limb, nerve conduction study

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Introduction:

Over the last 25 years, clinical neurophysiology has made many advances in the understanding, diagnosis, and even treatment of different movement disorders.¹ The methods which have proved useful for the detection, registration and quantification of various disturbances of function in the central or peripheral nervous system neuromuscular apparatus are grouped under one umbrella is called "clinical neurophysiology".

Advances in information and communication technology have promoted the use of computers by individuals for collecting, creating and transmitting the information. Computer assisted injuries, which started gaining prominence in India since past five years and have now turned into an epidemic resulting in computer related health problems.²

Epidemiological studies have shown that increased computer work coincided with a higher prevalence of work-related musculoskeletal disorders of the upper extremities (WRMSDs).³ These work related musculoskeletal disorders (WRMSDs) are defined as injuries or disorders of the muscles, nerves, tendons, joints, cartilage, and spinal discs associated with exposure to risk factors in the workplace.⁴ The characteristic features of WRMSDs are pain, associated paresthesia, subjective weakness, forearm weakness and fatigue with

regular computer use. It is therefore important to consider peripheral nerve involvement in the presence of these triad symptoms (mainly pain, paresthesia, and subjective weakness). Progressive functional impairments develop with chronic repetitive tasks and accompany signs of tissue injury.

Coordinated movement and skilled activities of upper limbs are essential in regular computer users. Long periods of uninterrupted work and holding same posture without break is the principal disadvantage of working at a computer.⁵ So, long hours of work at a computer can result in potential adverse effects like decrease in nerve sensitivity of peripheral nerves (median and ulnar). Nerve sensitivity is affected in early stage of nerve entrapment while impaired motor functions occur at late stage of Neuropathy.⁶

Studies have shown that there is injury, circulatory insufficiency and central nervous system involvement that lead to development of peripheral neuropathy in computer operators who work long hours at the computer. Study of nerve conduction is a part of electro-diagnostic procedure that helps in establishing the type and degrees of abnormalities of the nerves. It is used mainly for evaluation of paresthesia and weakness of the arms and legs.⁷

The aim of this study was to determine, the repetitive tasks performed by computer operators for long hours can lead to peripheral neuropathy as measured by nerve conduction velocity of the median nerve and ulnar nerve in mouse operating limb.

Material and Methods:

The study was performed in 60 healthy subjects of age group between 21 to 45 years in the department of Physiology after approval from Human Research Ethics committee of Government Medical College, Surat. After explaining procedure of the study, written and informed consent of the subjects was taken. Subjects were randomly selected on the basis of inclusion & exclusion criteria.

Inclusion criteria consisted of the following: Subjects of age between 21-45 years, Subjects of same race, Subjects of both the genders, Healthy volunteers from college and hospital staff at GMC and NCH, Surat, Group 1: 30 workers who worked on a computer for ≥ 6 hours/day since 2 years, Group 2: 30 workers who worked on a computer for ≤ 2 hours per week.

Exclusion criteria consisted of the following: Subjects with any metabolic disease, Compression neuropathy, Symptoms of abnormal sensation or numbness, Peripheral nerve injury, Radiculopathy/Cervical spondylosis, History of medication affecting neuromuscular system or initiation of such medication during the course of the study, Congenital Anomaly, H/O trauma/fracture, Uncooperative subject, H/O psychiatric disorder

Detailed clinical history was taken and thereafter relevant clinical examination was performed. Anthropometric measures were obtained and BMI was calculated. Vital signs were also recorded. Study participants underwent nerve conduction studies including electrophysiological measures (RMS EMG EP Mark II Recorders and Medicare Systems, Chandigarh India), using established methodology described by Mishra and Kalita.⁸

NEUROSTIM EMG/NCV/EP machine NS: 4-4 CHANNEL manufactured by Medicaid systems provided by Dept. of Physiology, GMC Surat was used for Determination of Nerve Conduction velocity.

Studies included conduction velocity for motor and sensory nerve testing on the median and ulnar nerves.

Observation

The study was performed in 30 case and 30 control (healthy subjects), of age group between 18 to 25 years in Department of physiology. Subjects were randomly selected on the basis of inclusion & exclusion criteria.

A detail of the Procedure was explained to the subjects prior to recording of objectives. Relevant clinical history was taken and clinical examination was done. Age, sex, height (in cm), and weight (in kg) were recorded. BMI was calculated⁹.

Right Median and Ulnar Nerves were tested for motor and sensory conduction and following parameters were recorded:-

1. Latency in milli-seconds (ms)
2. Amplitude in milli-volt (mv) and micro-volt (μ V) for Motor and Sensory nerves respectively.
3. Conduction velocity in meters per second (m/s).

Statistical Analysis:

Values are expressed as mean \pm SD. Microsoft Office Excel 2007 and SPSS statistics 17.0 software was used for data analysis. Comparison between two groups is done by unpaired 't' test. The probability level for significance was set at $P < 0.05$. $P > 0.05$ is considered as non- significant.

Table 1: Comparison of Various anthropometric measurements of cases and controls:

Parameters	Case(N=30) MEAN \pm SD	Control(N=30) MEAN \pm SD	P- value
Age (year)	30.97 \pm 6.06	28.30 \pm 6.39	> 0.05
Height (kg)	166.03 \pm 8.65	168.30 \pm 9.45	> 0.05
Weight (cm)	62.27 \pm 10.42	64.83 \pm 12.21	> 0.05
BMI kg/m ²	22.60 \pm 3.59	22.86 \pm 3.75	> 0.05

GRAPH 1: Comparison of Various anthropometric measurements of cases and controls:

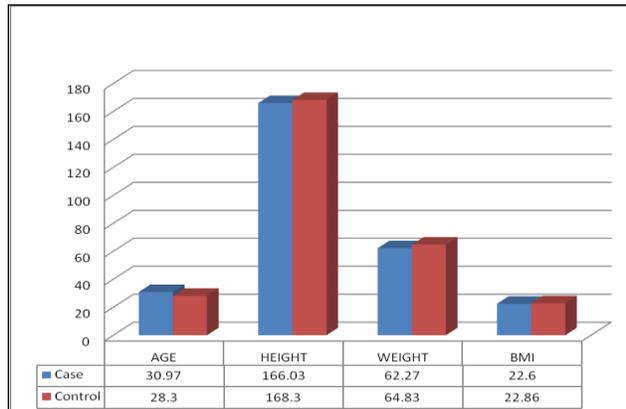


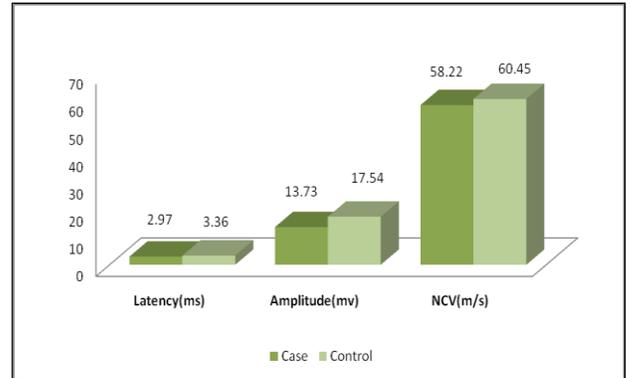
Table 2: Comparison of Right Median Nerve Conduction Study of Cases and Controls:

Nerve	Parameters	Case (N=30) MEAN±SD	Control (N=30) MEAN±SD	P-value
Reight median nerve (motor)	Latency (ms)*	2.97 ± 0.79	3.36±1	>0.05
	Amplitude (mv)**	13.73 ± 9.83	17.54± 9.83	>0.05
	NCV (m/s)	58.22 ± 2.82	60.45± 3.50	<0.05
Reight median nerve (sensory)	Latency (ms)*	2.29 ± 0.58	2.39±0.38	>0.05
	Amplitde (mv)**	78.15± 36.45	61.16± 33.16	>0.05
	NCV (m/s)	57± 3.24	59.75± 4.72	<0.05

*Distal motor latency measured from onset of action potential.

**Amplitude measured from peak to peak.

Graph 2: Comparasion of Right median (Motor) nerve conduction study :



Graph 3: Comparison of Right median nerve (Sensory) conduction study:

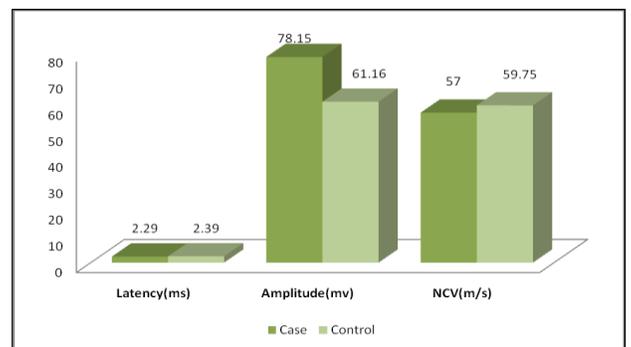


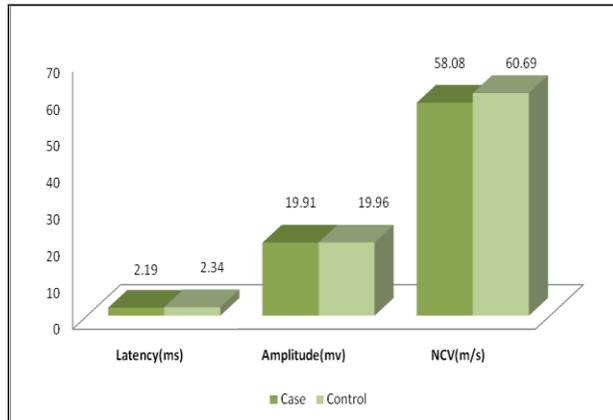
Table 3: Comparison of Right Ulnar Nerve Conduction Study of Cases and Controls:

Nerve	Parameters	Case (N=30) MEAN±SD	Control (N=30) MEAN±SD	P-value
Reight ulnar nerve (motor)	Latency (ms)*	2.19± 0.78	2.34± 0.55	>0.05
	Amplitude (mv)**	19.91± 5.15	19.96± 5.59	>0.05
	NCV(m/s)	58.08± 2.73	60.69± 4.24	<0.05
Reight ulnar nerve(sensory)	Latency (ms)*	2.23± 0.53	2.09± 0.31	>0.05
	Amplitude (mv)**	89.45± 39.97	82.55± 43.99	>0.05
	NCV(m/s)	57.46± 2.51	59.73± 3.41	<0.05

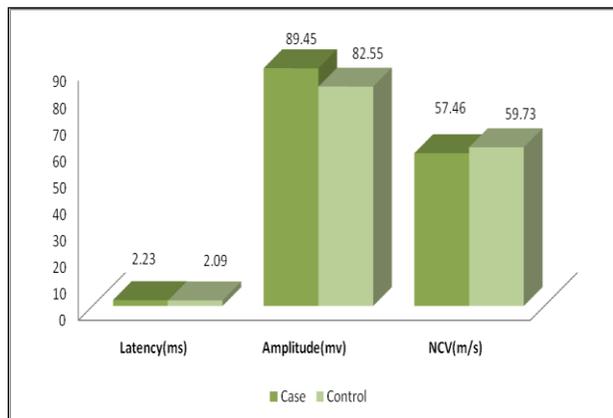
*Distal motor latency measured from onset of action potential.

**Amplitude measured from peak to peak

Graph 4: Comparison of Right ulnar nerve (Motor) conduction study:



Graph 5: Comparison of Right ulnar nerve (Sensory) conduction study:



Result: The demographic profile of subjects was comparable in two groups. **Table 1** and **graph 1** shows the age, height, weight and BMI distribution of cases and controls. The mean age of group 1 subjects (30.97 ± 6.06) was not significantly different from group 2 subjects (28.30 ± 6.39), mean height of group 1 subjects (166.03 ± 8.65) was not significantly different from group 2 subjects (168.30 ± 9.45), mean weight of group 1 subjects (62.27 ± 10.42) was not significantly different from group 2 subjects (64.83 ± 12.21), and BMI of group 1 subjects (22.60 ± 3.59) was also not significantly different from group 2 subjects (22.86 ± 3.75) ($p < 0.05$).

On analyzing **table – 2** and **graph - 2**, The Nerve conduction parameters of motor part of right median nerve in 30 cases and 30 controls, The conduction velocity was found to be lower in cases as compared to controls and Mean NCV in cases was 58.22(mV) and in controls was 60.45(mV) and it was significantly low in cases as compared to controls ($P < 0.05$) The mean distal latency and CMAP amplitude of right median motor nerve was found lower in cases than controls but the difference is statistically insignificant ($p > 0.05$)

On analyzing **table – 2** and **graph – 3**, The Nerve conduction parameters of sensory part of right median nerve in 30 cases and 30 controls, The conduction velocity was found lower in case as compared to controls. Mean NCV in cases was 57(mV) and in controls was 59.75(mV) which shows that it was significantly low in cases. ($P < 0.05$) (**graph – 3**) The mean distal latency and CMAP amplitude of right median motor nerve was found lower in case than control but the difference is statistically insignificant. ($p > 0.05$)

On analyzing **table - 3** and **graph - 4**, The nerve conduction parameters of motor part of right ulnar nerve in 30 cases and 30 controls, The nerve conduction velocity was found to be lower in cases as compared to controls. Mean NCV in cases was 58.08(mV) and in controls was 60.69(mV) which shows that NCV was significantly low in cases. ($P < 0.05$) The mean distal latency and CMAP amplitude of right ulnar motor nerve was found lower in cases than controls but the difference is statistically insignificant ($p > 0.05$)

On analyzing **table -3** and **graph - 5**, The nerve conduction parameters of sensory part of right ulnar nerve in 30 cases and 30 controls, The nerve conduction velocity was found lower in cases as compared to controls. The Mean NCV in cases was 57.46 (mV) and in controls was 59.73(mV) which shows that NCV was significantly low in cases ($P < 0.05$). The mean distal latency and CMAP amplitude of right ulnar sensory nerve was found lower in cases than control but the difference is statistically insignificant. ($p > 0.05$)

Discussion:

Work related musculoskeletal disorders are injuries and disorders of the nerves, muscles and tendons which are associated with repeated exposure to various risk factors. The use of computers involves

continuous repetitive strokes, persistent wrist extension during typing, and complete pronation of the forearm for operation of the computer mouse. All of these tasks involve repetitive motions, rendering computer operators more susceptible to WRMSDs.

The present study was undertaken in total 60 subjects out of which 30 were chronic computer operators and 30 were as controls. The age, height and weight of two groups were matched with no significant difference in anthropometric data or calculated BMI. So, both groups are comparable anthropomatically. (Table 1 and graph 1).

Table 2 and 3 shows that conduction velocity is decreased in the median and ulnar nerves for motor division in group I(cases) as compared to group II(controls). Unpaired t-test analysis showed that this difference is highly significant (p value <0.01). Bamac B et al.(2014) shows that the sensory conduction velocities of both median and ulnar nerves were significantly delayed in the dominant arm of the computer users compared to the controls. This study shows that computer users have a tendency toward developing median and ulnar sensory nerve damage in the wrist region. Mechanism of delayed SNCV in the median and ulnar nerves may be due to sustained extension and ulnar deviation of the wrist during computer mouse use and typing. Reduced SNCV changes were more apparent on the dominant side of the median nerve. This may indicate the increased neural deficits related to an increased use of the dominant side.¹⁰

Ganeriwal et al. (2013) also found that conduction velocities of peripheral nerves decreased in computer operators who work for long hours. Decreased conduction velocities confirm peripheral neural involvement (median and ulnar nerves) in these individuals. Studies have shown that there is injury, circulatory insufficiency and central nervous system involvement that lead to development of peripheral neuropathy in computer operators who work long hours at the computer.¹¹ The repetitive movements are inherent in computer use, and because of that friction are produced, which may lead to the inflammatory changes and resultant nerve compression. This compression leads to mechanical disruption of the blood nerve barrier, and indirectly compromises neural function by

restricting vascular perfusion. Depending upon duration of nerve loading from prolonged computer working hour, the magnitude, and increased localized pressure leads to axonal and myelin sheath disruption. This, in turn, increases the distances between the nodes of Ranvier and interferes with impulse transmission thus decreasing conduction velocity.

Leif A. Havton et al. (2007) studied the correlation of median forearm conduction velocity with carpal tunnel syndrome severity and concluded that slowing of median motor nerve conduction velocity in the forearm is related to the severity of entrapment of median motor fibers at wrist. It signifies that slowed forearm median motor nerve conduction velocity can be a marker of motor nerve injury at wrist.¹² Our findings were consistent with those of Murata et al.(1996) who assessed 27 female employees aged 19-37 entering data for more than 6 hrs./day, and found significant differences in median sensory conduction velocity.¹³ In contrast, to our study Sanden et al. (2005) reported no statistically significant difference in median nerve conduction velocity.¹⁴ Nathan et al.¹⁵ Described that nerve conduction studies have predictive value for future development of carpal tunnel syndrome. Study done by Myers showed that there was a strong, direct linear correlation between initial severity of symptoms and slowing and subsequent development of carpal tunnel syndrome.¹⁶

Conclusion:

In conclusion, the results of present study indicate that, NCV is a simple, reliable, and sensitive tool to measure and describe nerve conduction entrapment abnormality. Nerve conduction velocity in right hand for median and ulnar nerve is decreased and in long run could lead to carpal tunnel syndrome. There is a linear relationship between working hours on computer and decrease in nerve conduction velocity of upper extremities. So, we would like to suggest that the chronic computer workers can do some relaxation exercises intermittently for symptomatic relief and improvement of their performance.

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