A STUDY TO COMPARE NERVE CONDUCTION VELOCITIES IN DOMINANT AND NON-DOMINANT HANDS OF ADULTS

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Background and Objectives: Nerve Conduction Velocity(NCV) study is a part of Clinical Neurophysiology. Nerve Conduction Study is a test commonly used to evaluate the functions of the motor and sensory nerves of the body. It has emerged as a major tool for diagnosis of nerve function disorders. Handedness also known as chirality is a human nature due to unequal distribution of fine motor skills between the left and right hands. The aim was to compare the NCV between left handed and right handed subjects using median, ulnar and radial nerve and find out whether there is any difference in NCV(motor or sensory) with handedness. **Method:** The Nerve conduction study was performed on a RMS EMG EPMK II Electrophysiology machine. Motor and sensory NCV of the median, ulnar and radial nerves in the left and right upper limbs was compared in 50 right and 50 left handed subjects of both gender between 18 to 40 years. **Result:** Data analysis was performed through standard statistical methods. Median motor NCV was higher in right handed subjects. Sensory NCV were higher in left handed subjects **Conclusion:** Different range of values of motor and sensory nerve conduction velocity for left and right handed persons.

Key Words: Electrophysiology, Handedness, Nerve Conduction Study

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Introduction:

Recent technological advances have been of the utmost importance for the expansion in field of neuroscience. The methods which have proved useful for the detection, registration and quantification of various disturbances of function in the central or peripheral nervous system and neuro muscular apparatus are grouped under the term “Clinical Neurophysiology”.Nerve Conduction Velocity study is a part of Clinical Neurophysiology. Nerve Conduction Study is a test commonly used to evaluate the functions of the motor and sensory nerves of the body, especially the ability of electrical conductions. Nerve conduction study has emerged as a major tool for diagnosis of nerve function disorders. Handedness also known as chirality is a human nature due to unequal distribution of fine motor skills between the left and right hands. Individuals who are more dexterous with the right hand are called right-handed and those who are more skilled with the left is said to be left-handed[1.] Various cerebral functions like speech, language, visuospatial relations, analysis of face, and recognition of musical themes and use of hand for fine motor movements have also been studied with lateralization[2.] Handedness is primarily found to be due to difference in presentation of cerebral hemispheres. Genetic and heredity theory is quite successful in explaining the difference. Right-handedness is most common. In 96% of these individuals the left hemisphere is the dominant or categorical hemisphere and the rest 4% is having dominant right hemisphere. Studies suggest that 88–92% of the world population is right-handed. Left-handedness is far less common than right-handedness. About 15% of left handed individuals, right hemisphere seen categorical and in rest 15% there is no clear lateralization. For the remaining 70% of left handed individuals, categorical hemisphere is the left one[3.] Nerve Conduction Study is a pure physiological measure which involves no cognitive activity, of the speed with which the electrical impulses are transmitted along the peripheral nerve fibers and across synapses. The conduction velocity of the nerve depends on anatomical factors such as the fiber diameter, degree of myelination and the inter-nodal distance[4]. Effects of intrinsic factors like age and sex, as well as extrinsic factors like temperature on nerve conduction are well known[5]. In this study, same reference data will be used for nerve conduction velocities in both left and right handed persons. Here we have compared motor as well as

sensory nerve conduction velocity of median, ulnar and radial nerves between left (n=50) and right (n=50) handed adults (both male and female).The aim of this study was to compare the nerve conduction velocities using median, ulnar and radial nerves between right handed and left handed subjects and establish whether there is any difference in nerve conduction velocity (motor and/or sensory) with handedness and also between dominant hand and non-dominant hand of same individual (both right and left handed).

Material and Methods:

This study was conducted in the Electrophysiology laboratory, Department of Physiology, B. J. Medical College, Ahmedabad and Govt. Physiotherapy College and Spine Institute, Civil Hospital, Ahmedabad. Permission was obtained from the Institutional Ethical Committee. Informed written consent from the willing subjects was taken prior to the study. 100 adults (50 left and 50 right handed) in the age range of 18 to 40 years of both the gender were taken.

The subjects who have muscle weakness, a tingling sensation, diabetes mellitus, hypertension, chronic illness and pain or neuropathy were excluded from the study. Ambidextrous as well as those having any sign of nerve or muscle disorders, and peripheral nerve injury were excluded from the study. Pregnant ladies and those subjects who were not willing to participate in the study were also excluded.The complete history of every subject was taken before hand.During the study, the motor and sensory nerve conduction velocities of the median, ulnar and radial nerves in the left and right upper limbs was compared in 50 right handed and 50 left handed subjects.

The Nerve conduction study was performed on a RMS EMG EPMK II Electrophysiology machine. A standard 2 channel physiograph having one of the latest software in the study of nerve conduction was used for measurement.Materials required are stimulator circuit, Preamplifier, oscilloscope, electrode jelly, stimulating and recording electrodes: ring electrodes (sensory nerve conduction) and surface electrodes. Subjects were acclimatized to standard room temperature for 10 minutes. The participants were explained about the procedure and details of the nerve conduction study. A steady room temperature was maintained throughout the test. The room was quiet and comfortable. The area of the skin overlying the nerve was cleaned with spirit both in the proximal and distal end. The surface electrodes were fixed on the skin overlying the muscle supplied by the nerve.After that the procedure was performed.

After recording from each stimulation site, the latency was measured from the stimulus artefact to the take off i.e. first negative deflection from the baseline. The distance then was measured between each stimulation point, cathode stimulation point to cathode stimulating point. Dividing the distance between two stimulation points by the latency difference of the related response, conduction velocity was determined of that segment of the nerve in m/sec. Latency of response measured from time interval between stimulus and onset of electrical response. Parameters studied are sensory and motor nerve conduction velocities of both sides for left and right handed subjects. Thus, Conduction velocity = distance (mm) / L1-L2 ms.Where, L1 = Proximal latency, L2 = Distal latency.

Recorded data of subjects were entered in Microsoft Excel Worksheet which was then calculated. Data were presented in terms of mean +/− SD. Statistical analysis of the study was performed through standard statistical methods. Each group was compared by Z test. SPSS (Version 18) software was used for statistical calculation. P value less than 0.05 was considered as significant.

Result:

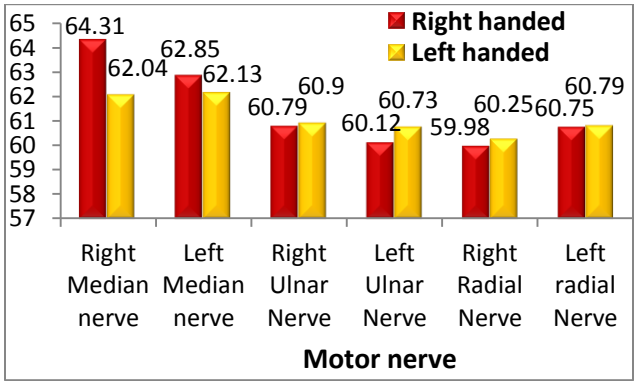
A total of 100 subjects (50 right handed subjects and 50 left handed subjects) were included in the study.

Table 1: Comparison of motor nerve conduction velocity in right and left handed subjects.

Motor nerve conduction velocity (m/sec)			
Nerves	**Right handed**	**Left handed**	**Z value (p value)**
Right Median nerve	64.31 ± 3.09	62.04 ± 2.48	4.64 (<0.05)
Left Median nerve	62.85 ± 2.32	62.13 ± 3.13	1.30 (>0.05)
Right Ulnar	60.79 ±	60.90 ±	0.23 (>

Nerve	2.15	2.60	0.05)
Left Ulnar Nerve	60.12 ± 2.74	60.73 ± 2.39	1.19 (> 0.05)
Right Radial Nerve	59.98 ± 2.51	60.25 ± 2.91	0.49 (> 0.05)
Left radial Nerve	60.75 ± 1.94	60.79 ± 2.40	0.09 (> 0.05)

Graph 1: Comparison of motor nerve conduction velocity in right and left handed subjects.

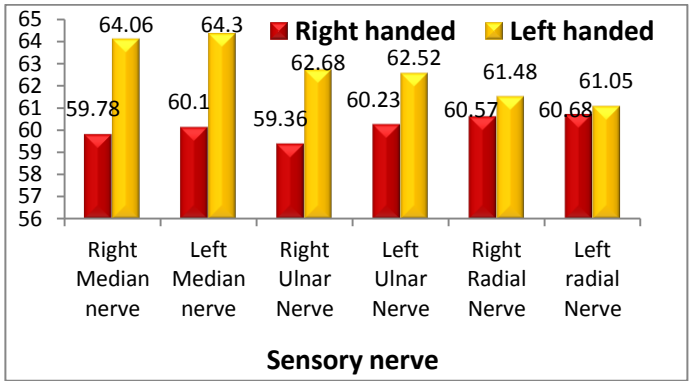


As shown in table 1 motor nerve conduction velocities (in meters per second) were higher in right median nerve in right handed individuals compared to left handed subjects (64.31 + 3.09 vs 62.04 + 2.48) and this difference was statistically significant (p< 0.05).Motor NCV (in meters per second) were higher in left median nerve in right handed individuals compared to left handed subjects (62.85 ± 2.32 vs 62.13 ± 3.13) and this difference was not statistically significant (p >0.05). Motor NCV (in meters per second) were higher in radial and ulnar nerves tested in left handed individuals compared to right handed subjects but the difference was not statistically significant .

Table 2: Comparison of sensory nerve conduction velocity in right and left handed subjects.

Sensory nerve conduction velocity (m/sec)			
Nerves	**Right handed**	**Left handed**	**Z value(p value)**
Right Median nerve	59.78 ± 3.34	64.06 ±2.21	7.55 (<0.05)
Left Median nerve	60.10 ± 3.43	64.30 ± 1.97	7.51 (<0.05)
Right Ulnar Nerve	59.36 ±2.68	62.68 ± 1.99	7.03 (<0.05)
Left Ulnar Nerve	60.23 ± 1.87	62.52 ± 2.54	5.13 (<0.05)
Right Radial Nerve	60.57 ±3.13	61.48 ± 1.68	1.82 (>0.05)
Left radial Nerve	60.68 ± 3.16	61.05 ± 2.23	0.67(>0.05)

Graph 2: Comparison of sensory nerve conduction velocity in right and left handed subjects.



As shown in this Table 2 sensory nerve conduction velocities of median, ulnar and radial nerves of both the sides in left handed individuals were higher compared to their right handed counterparts as shown in table 2 but this difference was significant only in the Median and ulnar nerve (p <0.05).

While comparison of nerve conduction between two different upper limbs of Right handed persons, we did not found any significant difference (Table 3). Similar result was observed in left handed person (Table 4).

Table 3: Comparison of nerve conduction between two different upper limbs of Right handed persons.

Motor nerve conduction velocity (m/sec)			
Nerves	**Right upper limb**	**Left upper limb**	**Z value (p value)**
Median nerve	64.31 ± 3.09	62.85 ± 2.32	2.81 (>0.05)
Ulnar nerve	60.79 ± 2.15	60.12 ± 2.74	1.37 (>0.05)
Radial nerve	59.98 ± 2.51	60.75 ± 1.94	1.70 (>0.05)

Sensory nerve conduction velocity (m/sec)			
Median nerve	59.78 ± 3.34	60.10 ± 3.43	0.47 (>0.05)
Ulnar nerve	59.36 ± 2.68	60.23 ± 1.87	1.89 (>0.05)
Radial nerve	60.17 ± 3.13	60.68 ± 3.16	0.82 (>0.05)

In right handed persons, motor conduction velocity in median nerve and ulnar nerve of right upper limb was slightly higher than left upper limb but statistically not significant (p >0.05). Sensory conduction velocity of all three nerves in left upper limb was higher than right upper limb but statistically not significant (p >0.05).

Table 4: Comparison of nerve conduction between two different upper limbs of Left handed persons.

Motor nerve conduction velocity (m/sec)			
Nerves	**Right upper limb**	**Left upper limb**	**Z value (p value)**
Median nerve	62.04 ± 2.48	62.13 ± 3.13	0.15 (>0.05)
Ulnar nerve	60.90 ± 2.60	60.73 ± 2.39	0.34 (>0.05)
Radial nerve	60.25 ± 2.91	60.79 ± 2.40	1.01 (>0.05)
Sensory nerve conduction velocity (m/sec)			
Median nerve	64.06 ±2.21	64.30 ± 1.97	0.58 (>0.05)
Ulnar nerve	62.68 ± 1.99	62.52 ± 2.54	0.35 (>0.05)
Radial nerve	61.48 ± 1.68	61.05 ± 2.23	1.11 (>0.05)

In left handed persons, motor conduction velocity in median nerve and ulnar nerve of right upper limb was slightly higher than left upper limb but statistically not significant (p >0.05). Sensory conduction velocity in ulnar and radial nerve in right upper limb was higher than left upper limb but statistically not significant (p > 0.05).

Discussion:

The human motor system adapts to the functional requirements with considerable plasticity. Low intensity exercise on repetition during endurance training results in contractile slowing of the muscle, enhanced aerobic capacity and fatigue resistance. High-resistance training induces muscle fiber hypertrophy and concomitantly increased maximal force output. Depending on the use of a particular muscle, there were changes in its physiological characteristics and mechanical response. Long-term preferential use of selected muscles can be viewed as a moderate form of exercise. In the past decade, several researchers reported differences in physiology between the dominant and the non-dominant upper limb[8].

In our study, Table No.1 shows that motor nerve conduction velocities were higher in all the nerves tested in left handed individuals compared to right handed subjects except for right and left median nerve. Motor nerve conduction velocities were higher in right median nerve in right handed individuals compared to left handed subjects(64.31 + 3.09 vs 62.04 + 2.48) and this difference was statistically significant. Motor nerve conduction velocities were also higher in right median nerve in right handed individuals compared to left handed subjects(62.85 + 2.32 vs 62.13 + 3.13) and this difference was not statistically significant. Similar result was observed in the study conducted by Soumya BA[9].

As we can observe both in Table No.1 & 2, our study seems similar with the study of Navin Gupta, SharmilaShaniyal and Rashmi Babbar[10]. In their study, correlations between handedness and motor as well as sensory conduction velocity of right and left median nerve were studied in 84 medical students in the age group of 17-21 years. 72 students were right handed and 12 were left handed. Sensory nerve conduction velocity in both right and left median nerve was significantly higher in left handed subjects as compared with right handed subjects. On the contrary, motor conduction velocity in right handed subjects and left handed subjects was not different. Higher sensory nerve conduction velocity in left handed persons may be because of genetic reasons [11, 12], which can be due to functional differences during the growth in early childhood. As there is greater sensory conduction velocity in left handed persons, requirement of different set of normal reference

values for left handed persons in clinical diagnosis is there.

Tan U[13] et al. from Ataturk University, Medical Faculty, Department of Physiology, Erzurum, Turkey conducted a study on lateralization in the sensory and motor nerve conduction velocities. In right handed normal subjects, on measurement of nerve conduction velocity, sensory nerve conduction velocity is obtained higher on left hand in comparison to right hand. However, it was observed that motor conduction velocity measured in median nerve was considerably higher in right hand than that of the left hand. As a result, it was concluded that fast conducting neuromuscular junctions on the right hand muscles would give rise to relatively fast right hand in right-handed persons. Relative fast conducting in sensory nerves in the left hand may contribute to a relatively better perception by right cerebral hemisphere in right handed persons. His study finding was in concurrence with our Table.No.1 & 3.

Furthermore, Tayade.M.Cet al.[14] assimilated 40 healthy subjects of 18-25 years age to evaluate effect of limb dominance. Half of the subjects were right and the other half was left handed. He too, did not observe any statistically significant difference in nerve conduction velocity in dominant and non-dominant hands. This finding was found to be similar with our Table No.3 & 4. Nevertheless in relation with sensory nerve conduction velocities some variations were noted. It was observed that sensory nerve conduction velocities were significantly higher in left handed subjects than right handed subjects. This result was coinciding with our study as we can see in the table No.2.

Table No.3 & 4 of our study shows similarity with the findings of the study conducted by Bhorania S & Ichapora[15], at Topiwala national medical college, Mumbai, appointed 50 medical students who were then divided in two groups of 25 each, based on their handedness. Their motor nerve conduction velocity of Median and Ulnar nerve was studied. The study revealed that there was no major difference in velocity between dominant and non-dominant limbs in same individuals, but nerve conduction in right handed subjects was more when compared to their counterparts for both dominant and non-dominant limbs. Their study indicates that there should be separate set of normative data for both right and left-handed individuals to be used in practice. Bhorania also reported greater velocity in median nerve of right handed subjects compared to left handed subjects but not significant difference. This could be due to the fact that motor neurons of spinal cord supplying right upper limb were found to be larger as compared to left upper limb and median nerve has greater dermato-myotomal distribution than the ulnar nerve[16]. Higher sensory nerve conduction velocities in left handed subjects may be because of genetic reasons and this may contribute to functional differences during growth in early childhood.

Handedness in relation to radial nerve studies for both motor and sensory nerve conduction was not found significant by us. Sunil Chouhan, Assistant Professor, Department of Physiology, All India Institute of Medical Sciences (AIIMS), Bhopal studied normal motor and sensory nerve conduction velocity of Radial Nerve in young adult medical students[17]. The study suggested that the normative value of motor and sensory NCV of radial nerve in male and female subjects were within the favorable range as compared with the existing data for radial nerve. There were no difference statistically found in the radial nerve motor and sensory NCV of right and left hand of the same person in either sex. This was synchronous with our observation of Table.No3 & 4. Further, we could not find much reference for radial nerve study in relation to handedness

Conclusion:

Here, in our study, we reached to the following conclusions that motor nerve conduction velocities do not significantly change with dexterity in ulnar and radial nerves except for median nerve. Median motor nerve conduction velocity was higher in right handed subjects than the left handed. Significance was seen only in right median nerve. Sensory nerve conduction velocities of median, ulnar and radial nerves were higher in left handed subjects than their counterparts and this was found to be significant in median and ulnar nerves. Significant difference in sensory nerve conduction could be because of genetic reasons contributing

to functional differences during growth in early childhood. Further, this difference should be taken into account before making any neurological diagnosis in left handed subjects. It was seen that both in right handed and left handed adults motor nerve conduction velocities of median, ulnar and radial nerves did not significantly differ in the dominant and non-dominant upper limbs of the same individual. Sensory nerve conduction velocities of median, ulnar and radial nerves both in right handed and left handed adults did not show significance when compared between the dominant and non-dominant upper limbs of the same individual.

There should be a separate set of reference values for the two groups. If the same set of reference values is used for all individuals, the chances of error in diagnosing will increase and a normal healthy individual would wrongly be labelled as a patient suffering from nerve disorder.

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Disclosure: No conflicts of interest, financial, or otherwise are declared by authors.