Available Online at http://www.recentscientific.com

ISSN: 0976-3031

International Journal of Recent Scientific Research
Vol. 5, Issue, 12, pp. 2250-2255, December, 2014

International Journal of Recent Scientific Research

RESEARCH ARTICLE

STUDY OF NERVE CONDUCTION VELOCITY IN MEDIAN NERVE OF HEALTHY MALE AND FEMALE OF DIFFERENT AGE GROUPS

[1]Abhishek Kumar, [2]Roohi F and [3]Anjali Prasad

[1]Department of Physiology, Index Medical College, Hospital & Research centre, Indore MP
[2]Head Department of Physiology, Index Medical College, Hospital & Research centre, Indore MP
[3]Department of Anatomy, Index Medical College, Hospital & Research centre, Indore MP

ARTICLE INFO

Article History:

Received 6th, November, 2014
Received in revised form 16th, November, 2014
Accepted 8th, December, 2014
Published online 28th, December, 2014

Key words:

Nerve Conduction Velocity (NCV), Motor Nerve Conduction Study (MNCS), Compound Muscle Action Potential (CMAP), Median Nerve, Gender.

ABSTRACT

Introduction: The reference values for NCV for different nerve vary considerably from population to population & from region to region. There are number of factors that affect NCV like age, gender & temperature. The importance of MNCS for the evaluation of the functional status of the patient's median nerve for comparing the effect of therapeutic intervention with various diseases that affect NCV is well known in various studies.

Aims: To establish the normal electrophysiological data, NCV variables i.e. CMAP for the Rt. Median Nerve in normal healthy adults and to study the effect of gender on NCS variables in healthy adults.

Materials and Method: All together 38 females and 80 male subjects, from first year MBBS, BDS, Staff members of Index Medical College Hospital & Research Center, Indore (M.P), between age group of 20 to 60 years were evaluated. All tests were done on JAVA RMS Aleron-201 series. Analysis was done using statistical package for social sciences (SPSS) 10.0 version.

Results: The mean ages of male were more than that of female with P value non-significant. The mean NCV elbow-wrist of males were more than that of female with P value = 0.038 which was found to be highly-significant.

Conclusion: The normative conduction parameter of commonly tested peripheral nerve in upper limb could be used for the evaluation of peripheral nerve injury. Gender has definite effect on NCS variables Diagnostic conclusion could also be made from the nerve conduction study data.

INTRODUCTION

Nerve conduction velocities (NCV) can be easily measured on peripheral nerve. Electro-diagnostic assessment of peripheral nerve includes two major component nerve conduction study (NCS) and needle electromyography (EMG) (Mishra U K *et al*. 2nd Ed. B.I. Churchill livingstone.)

There are several factors which may influence nerve conduction study such as Age, Height, Gender, BMI etc. They have to be taken into consideration while doing nerve conduction study. However these factors vary according to different geographic region. Many studies had been published regarding normative data from western countries with cold climatic condition (Chouhan S. 2011).

A nerve conduction study is a test commonly used to evaluate the function especially the ability of electrical conduction of the motor and sensory nerves of the human body. Nerve conduction velocity (NCV) is a common measurement made during the test which measures how quickly electrical impulses move along a nerve. It is often done at the same time as an EMG, in order to exclude or detect muscle disorder.
A healthy nerve conducts signals with greater speed and strength than a damaged nerve. The speed of nerve conduction is influenced by the Myelin Sheath the insulating coating that surrounds the nerve. Most neuropathies are caused by damage to the nerve axons rather than damage to the Myelin Sheath surrounding the nerve. (Mishra U K *et al*. 2nd Ed. B.I. Churchill livingstone.)

Median nerve and ulnar nerve are two important nerves in the upper limb. They are responsible for the movement as well as sensation of the hand. Entrapment of these nerves will cause reduction in these modalities for instance in carpal tunnel syndrome.

The primary purpose of this study was to provide normative electrophysiological data for commonly tested upper limb nerves in carefully screened normal healthy adults individual using standard distance and temperature control.

* Corresponding author: **Abhishek Kumar**
Department of Physiology, Index Medical College, Hospital & Research centre, Indore MP

Aims and Objectives

1. To establish the normal electrophysiological data NCV variables i.e. CMAP for the Rt. Median in normal healthy adults.
2. To study the effect of gender on NCV in Rt. Median nerve in healthy adults.
3. The objective of this present study was to determine reference value for motor NCV in young healthy adults.

MATERIAL AND METHODS

Study Population

The present study was carried out in neurophysiology laboratory of physiology dept. of Index Medical College Hospital and Research Centre, Indore (MP) from June 2012 to March 2013. The subject included in the study were 1st yr. MBBS student, 1st yr. BDS student & Nursing student, staff member of this institute.

Selection Criteria

Healthy individual of different age group (20-60) yrs. free of any neurological disorder or problem or any history of it.

Exclusion Criteria

1. Any individual of neurological disorder or neuromuscular transmission disorder.
2. Any individual suffering from diabetes.
3. Any individual suffering from renal disorder.
4. Any individual suffering from weakness of upper limb and lower limb or myopathy.

Protocol

Informed consent was obtained from the individual. The examination was performed in a calm setting after the patient was thoroughly briefed about the procedure and rest for 30min. Considerable gap was given between examination, so as to minimize discomforts to subject as well as to enhance their enthusiastic participation.

Electrophysiological Methods

All tests were done on JAVA RMS Aleron-201 series. The JAVA RMS Aleron-201 series is a clinically customized for a quick and flexible operation. Its software and hardware is particularly designed with the consideration of actual test being done in the field machine which can be totally customized for various test, nerve muscle and size with computer choice of amplifier filter and sweep setting and also analytical setting like marker.

The nerve conduction study was performed in a separate room without any air-conditioning facility but the room temperature was between 30-31° C. Further subject should be made comfortable with the laboratory set up, so as to completely relax. For median nerve the active surface electrode should be put over the motor point of abductor pollicis brevis(APB) in upper third of thenar eminence close to 1st Metacarpophalengeal joint and stimulating electrode was kept at the ante-cubital fossa proximally and wrist distally and ground electrode at the back of palm.

For each subject, data of distal motor lat1, lat2, motor nerve conduction velocity (MNCV) and compound muscle action potential (CMAP) from the distal stimulation were included from statistical analysis in this study.

CMAP has following component which is defined as

I. Amplitude- It is measured from base line to the positive peak.
II. Latency1:-This is the time from the stimulus to the initial positive deflection off the baseline.
III. Latency2:- Time taken for 1st deflection of CMAP after stimulation at S2 (site).
IV. Duration: - It correlates with the density of small fibres. It is measured from the onset to the positive peak.
V. Area: - The area comes from the difference between the lat1 and lat2. However it needs computer analyses.

In each subject orthodromic motor parameter of the nerve were measured. Surface electrodes were used. The recording electrodes were fixed to the subject's skin using adhesive tape. No special skin preparation was needed. The targeted nerve was supra maximally stimulated using a square wave current with duration 0.2ms and the action potential was picked up by the recording electrode. The length of each nerve was estimated with a flexible measuring tape. For safety a ground electrode was placed in between the stimulating and recording electrode. (Mishra U K *et al*. 2nd Ed. B.I. Churchill livingstone.)

Principle of Motor Nerve Conduction

The motor nerve is stimulated at least at two points along its course. The pulse is adjusted to record a compound muscle action potential (CMAP). It is important to ensure a supra maximal stimulation keeping the cathode close to the active recording electrode. This prevents hyper polarization effect of anode and anodal conduction block. The surface recording electrode was commonly used and placed in belly tendon montage, keeping the active electrode close to the motor point and reference to the tendon. Ground electrode was placed between stimulating and recording electrode. A biphasic action potential with initial negativity was thus recorded. Surface stimulation of healthy nerve requires a square wave pulse of 0.1ms duration with an intensity of 5-40mA. Filter setting for motor nerve conduction study was 20Hz to 3 KHz and sweep speed was 10ms/division.

The measurements for motor nerve conduction study include the onset latency, duration and amplitude of CMAP and nerve conduction velocity. The latency is the time in milliseconds from the stimulus artefact to the first positive deflection CMAP for better visualization of the take off, the latency should be measured at a higher gain than the one used for CMAP amplitude measurement.

The latency is a measure of conduction in the fastest conducting motor fibres. It also includes neuromuscular transmission time and the propagation time along the muscle membrane from the baseline to the positive peak. The amplitude co-relates with the no. of nerve fibres. The duration of CMAP was measured from the onset to the positive peak. Duration Co-relates with the density of small fibres. The area under CMAP was also measured. However it was computer generated analysis.

Motor nerve conduction velocity was calculated by measuring the distance in millimetre between two points of stimulation,

which is divided by the latency difference in millisecond. The nerve conduction velocity was expressed as m/s.

Conduction velocity: - $\frac{D}{PL-DL}$m/s **(Pal G.K. 2011)**

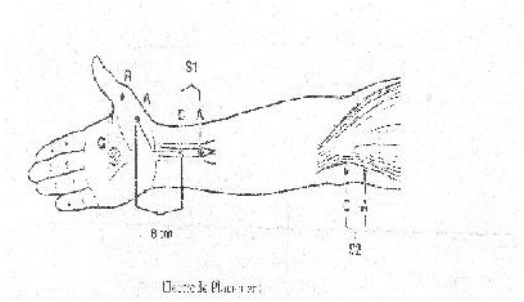
- Where PL is the proximal latency and
- DL is the distal latency and
- D is the distance between the Proximal and distal latency.

Recording Procedure

Motor NCS Variables

Estimator with water soaked felt tips were placed at rt. Median nerve which was recorded as

Rt. Median Nerve



Median nerve is a mixed nerve derived from C5 to T1, roots via medial and lateral cords of brachial plexus. It supplies most forearm flexors and thenar muscles and provides sensory innervations to the lateral aspect of palm and dorsal surfaces of terminal phalanges along with the palmer surface of thumb, index, middle and half of ring fingers.

Position

This study was performed in the supine position.

Active Electrode

Placement was half way between the mid-point of distal wrist crease and first Metacarpophalengeal joint.

Reference Electrode

Placement was slightly distal to the first Metacarpophalengeal joint.

Ground Electrode

Placement was on the dorsum of the hand. If stimulus artefact Interferes with the recording, the ground may be placed near the active electrode, between the electrode and the cathode.

Stimulation Point (S1)

The cathode was placed 8cm proximal to the active electrode in a line measured first to the mid-point of the distal wrist crease and then to a point slightly ulnar to the tendon of the flexor carpi radialis. The anode was proximal.

Stimulation Point (S2)

The cathode was placed slightly medial to the brachial artery pulse in the ante-cubital region. The anode was proximal.

Nerve Fibre Tested

C8 and T1 nerve root through the lower trunk of the anterior division and medial cord of the brachial plexus.

Machine Setting

Sensitivity -10mv/division, low frequency filter-20H2 and high frequency filter– 3KHzand sweep speed -10msec/division.

Care should be taken to concomitantly stimulate the ulnar nerve. The direction of thumb twitch would help in making sure that only median nerve was stimulated. (Buschbacher RM. 1978)

Applied

Entrapment of median nerve leads to three important syndromes.

(i) Carpal tunnel syndrome.
(ii) Anterior interosseous syndrome.
(iii) Pronater teres syndrome.

Comparison of effect of age of various studies comprising of different components Of CMAP and NCV with the present study.

S. No.	Study By	No. of Subject.	Age Gr.	Segment	Lat1(ms)	Lat2(ms)	Duration (ms2)	Amp. (mv)	Area (mu)	NCV
1.	Ginzberg M[8] *et.al*	21	26-55	Elbow Wrist	3.2(0.4)	-------	-------	12.1(3.8)	------	45.1-54.4
2.	Falco FJ[9] *et.al*	44	Young Adults	------	3.7(0.5)	------	------	10.2(3.6)	------	------
3.	Buschbacher[4]	249	----	----	----	-----	-----	-----	-----	-----
4.	Kimura[10] *et.al*	61	11-74	Wrist Elbow	3.49 ± 0.34 7.39 ± 0.69	----	----	7.0 ± 3.0 7.0 ± 2.7	-----	---- 5.77 ± 4.9
5.	Misra UK[1] *et.al*	26	16-35	Wrist Elbow	3.77 ± 0.40 7.62 ± 0.65	----	----	8.10 ± 2.62	----	----
6.	Chouhan S[11]	50	17-20	Wrist Elbow	3.54± 0.43 7.21 ± 0.69	----	----	17.84 ± 3.41 10.63 ± 3.96	----	---- 58.85 ± 3.57
7.	Present Study	80	20-60	Elbow Wrist	8.34 ± 2.28 3.06 ± 1.03	21.98 ± 9.92 18.55 ± 6.96	13.50 ± 4.59 15.38 ± 7.13	4.63 ± 3.41 2.31 ± 1.65	19.3 ± 11.7 23.8 ± 16.4	69.1 ± 29.8

Comparison of effect of gender on motor nerve conductionvariables(CMAP) with other study

S.No.	Study By	Motor No.	Gender	Site	Lat1	Lat2	Duration	Amplitude	Area	NCV
1.	Thakur D[12]	Rt. Median Nerve	Male Female P Value	Antecubital Fossa	9.28 ± 0.96 8.54 ± 0.59 0.017	25 ± 2 22.56 ± 1.18 0.001	8.46 ± 1.30 7.5 ± 1.03 0.021	10.47 ± 3.14 7.75 ± 2.39 0.021	------ ------ ------	-------
2.	Present Study	Rt. Median Nerve	Male Female P Value Male Female P Value	Elbow Wrist 	8.34 ± 2.28 8.79 ± 3.46 0.470 3.06 ± 1.03 3.76 ± 1.74 0.027	21.87 ±9.92 21.14 ± 5.83 0.498 18.55 ± 6.96 16.62 ± 4.82 0.083	13.50 ± 4.59 12.56± 4.52 0.297 15.38 ± 1.13 12.86 ± 4.92 0.028	4.63 ± 3.41 4.19 ± 4.00 0.521 2.31 ± 1.65 2.90 ± 2.13 0.143	19.3 ± 11.7 16.6 ± 13.6 0.297 23.8 ± 16.4 22.1 ± 15.4 0.584	NCV elbow wrist segment Male= 69.1 ± 29.8 Female= 55.9 ± 32.4 P Value = 0.03 Significant.

Statistical Methods

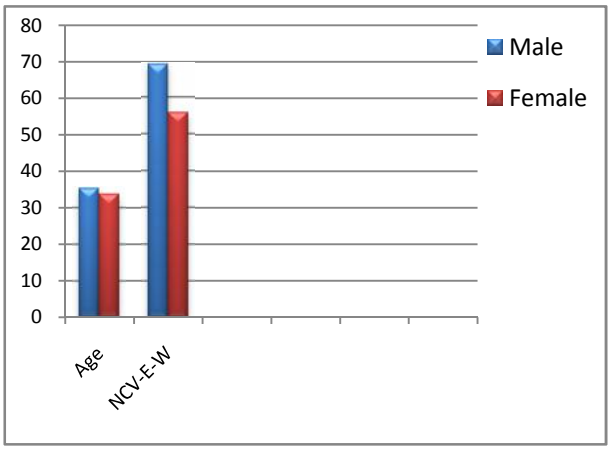
Analysis was done using statistical package for social sciences (SPSS) 10.0 version. Values obtained were expressed in the form of mean and standard deviation (SD). P-value was taken as significant if it was found to be less than 0.05. The test used was z-test with two sample mean.

OBSERVATIONS AND RESULTS

Table 1 Comparison Of Mean Age And Ncv For Male And Female

S. No.	Parameter	Range	Male n = 80	Female n =38	Statistical analysis
1.	Age	20-60 yrs	35.4 ± 12.7	33.8 ± 13.7	Pvalue = 0.542 Df = 68 Non significant
2.	NCV of rt. median nerve(elbow-wrist segment)	29.67-93.36 m/sec	69.1 ±29.8	55.9 ± 32.4	T = 2.22 P = 0.038>0.05 Df. 67 highly Significant

PARAMETER	Male	Female
Age	35.4	33.8
NCV-e-w	69.1	55.9



Graph 1 comparison of mean age and ncv for male and female.

Wrist- The mean difference for parameters Lat1, Duration are found to be significant (p<0.05) between gender, where as all other parameter Lat2, amp and area are non-significant (p>0.05).

Elbow- The mean difference for all parameters i.e. Lat1, Lat2, Duration, Amp and Area show non-significant differences (p>0.05) between gender.

Wrist- The mean difference for parameters Lat1, Duration are found to be significant (p<0.05) between gender, where as all other parameters Lat2, amp and area are non-significant (p>0.05).

DISCUSSION

118 healthy individual were studied over a period of 1 year from June 2012 to May 2013 in neurophysiology lab. of physiology dept. of Index Medical College Hospital and Research Centre. There were 80 male and 38 females in the study group. The study shows the association of biological factors i.e. Age and gender which was further supported by previous studies.

In adult, nerve conduction velocity decreases with age as it starts to decline at a rate of 1.5 percent per second, more so in the upper limb than the lower limb. This was related to gradual loss of neuron with aging. A similar observation was made by Flack B [5] *et al* 1993 for motor nerve conduction

Table 2 Effect of Gender on Motor Nerve Conduction Variables (Cmap)

S. No.	Motor nerve	Site of stimulation	Age range	Gender	No. of subject	Compound muscle action potential CMAP variables				
						M±SD	M±SD	M±SD	M±SD	M±SD
						Lat 1 (ms)	Lat 2 (ms)	Dur (ms)	Amp (ms)	Area (ms)
I	Rt median nerve	1.Elbow	20-60	(i) Male	80	8.34±2.28	21.87±9.92	13.50±4.59	4.63±3.41	19.3±11.7
				(ii)Female	35	8.79±3.46	21.14±5.83	12.56±4.52	4.19±4.00	16.6±13.6
					Statistical analysis	T=0.73 P= 0.0470 Non significant	T=0.68 P= 0.498 Non significant	T=1.05 P= 0.297 Non significant	T=0.65 P= 0.521 Non significant	T=1.05 P= 0.297 Non significant
		2.Wrist	20-60	(i) Male	80	3.06±1.03	18.55±6.96	15.38±7.13	2.31±1.65	23.8±16.4
				(ii)Female	35	3.76±1.74	16.62±4.82	12.86±4.92	2.90±2.13	22.1±15.4
					Statistical analysis	T=2.28 P=0.027 Df. 49 Significant	T=1.75 P= 0.083 Non significant	T=2.23 P= 0.028 Df.= 10.0 significant	T=1.48 P= 0.143 Non significant	T=0.55 P= 0.584 Non significant

Table No. 1 and graph No. 1 shows that the mean ages of the study subjects (male 35.4 ± 12.7 and female 33.8 ± 13.7) were not significantly different between genders. The mean NCV Elbow-wrist of male is more than that of female with P value = 0.038 which is found to be highly-significant. Its range is in between (29.67-98.36 m/sec).

Table No. 2 and graph no. 2 & 3 shows:

Table No. 2 shows: Elbow- The mean difference for all parameters i.e. Lat1, Lat2, Duration, Amp and Area show non-significant differences (p>0.05) between gender.

velocity. The present study shows decrease in NCV as age advances. Tong HC [6] *et al* 2004 in their study on the effect of aging on motor nerve noted that the rate of change in parameter was significantly greater in the median nerve than the ulnar.

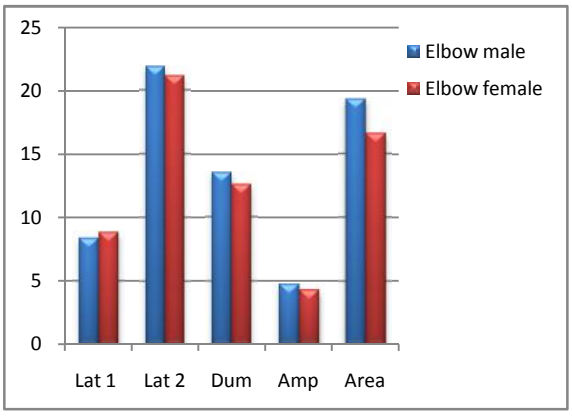
The age factor was negatively correlated to amplitude in motor nerve conduction study conducted by Chi – ren – huang [7] *et al* 2009. The present study showed that the conduction velocity was slightly more in upper limb than lower limb as this was attributed to the length of the nerve.

On comparing the present study for the adult between 20-60 yrs the NCV for elbow-wrist segment found to be more than that of Chouhan[11,] Kimura [10], Ginzberg M [8] . While comparing

Graph 2 Showing Effect of Gender on Motor Nerve Conduction Variables (Cmap) Of Elbow Region

CMAP	Elbow male	Elbow female
Lat 1	8.34	8.79
Lat 2	21.87	21.14
Dum	13.5	12.56
Amp	4.63	4.19
Area	19.3	16.6

The CMAP its component LAT1 for the elbow was found to be more in the present study as compared to various studies. Present study also shows the calculation of NCV of elbow-wrist segment and area while these parameters were not calculated by various workers. So our study was first of its kind.



Elbow

Graph No 3 Showing Effect of Gender on Motor Nerve Conduction Variables (Cmap) Of Wrist Region

CMAP	Wrist male	Wrist female
Lat 1	3.06	3.76
Lat 2	18.55	16.62
Dur	15.38	12.86
Amp	2.31	2.9
Area	23.8	22.1

The conduction velocity of nerve was low in infant and children. In neonates, it was nearly half of the adult values. It attains the adult value by three to five years of age, and then it remains relatively stable until sixty years of age.

Gender

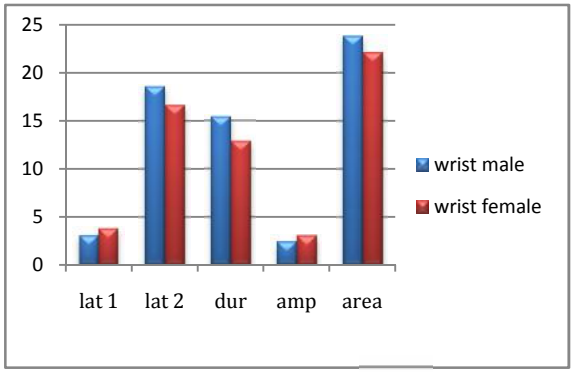
The following parameters were analyzed in the present study in relation to gender as

1. ***Age:-*** Out of total no. of cases 80 male with M±Sd of 35.4 ± 12.7 and 38 female with M±Sd of 33.8 ± 13.7 in the age range of 20 to 60 years and p value = 0.54 which is found to be statistically non-significant.
2. The NCV of Rt. Median nerve (elbow-wrist segment) was 69.1± 29.8 for the male which was more than that of female who had NCV 55.9 ± 32.1 with p value = 0.0387 and was highly significant.
3. ***CMAP:-*** In previous reports, gender difference in some NCS can be largely explained by height although amplitude difference still persist despite correction report gender has definite effect in NCV variables as

I. ***At elbow:*** - Lat**1** was slightly increased while other parameter of CMAP was slightly decreased in females as compared to male.

II. ***At wrist:*** - There was a reduction in lat**2,** amp, area and they were not statistically significant for female while lat1, in female was more and duration was less than that of male and was statistically significant.

III. The NCV of elbow-wrist segment of male was more than that of female and was significant.



Wrist

In contrast to present study, Thakur D[12] *et al* 2010, found an increase in all component of CMAP for male as compared to female and was statistically significant for ante-cubital fossa. While present study showed a decrease in all NCV variables i.e. CMAP except duration but they were non-significant. In present study area was also calculated because of computer analysis. Thakur *et al* didn't calculated area and NCV for the gender of upper and lower limb.

Soudman R[13]*et al* 1982 reported that nerve conduction velocity is not influenced much by gender . Gender differences in nerve conduction parameter could also be due to difference in height. While according to Kimura[10] *et.al* 1973 gender related amplitude differences persist despite adjustment of height. As male has thicker subcutaneous tissue which provides greater distance between digital nerve and surface ring electrode as compare to female. While Garg R[14]*et al* 2013found that male had a higher CMAP and longer latencies and duration than the females.

CONCLUSION

In conclusion the normative conduction parameter of commonly tested peripheral motor nerve in upper limb was established in our neurophysiology laboratory of the department of Physiology of our institute. The present study could be used for the evaluation of peripheral nerve injury. Diagnostic conclusion could also be made from the nerve conduction study data.

The study created a preliminary normative data of our population abet in a limited sample. A study with larger sample size will certainly add more strength. Our present studies have many similarities and some dissimilarity with the reported NCS variable (i.e. CMAP). The present study reported high conduction velocity as compared to other worker i.e. (*Thakur D*[12]*et al* 2010). The probable reason could be true differences among population and small sample sizes, nevertheless the normative data may be used as preliminary working reference while reporting clinical NCS finding. In this way these studies hold a big strength.

References

1. Mishra UK, Kalita J. Clinical Neurophysiology – Nerve conduction, Electromyography and evoked potentials. 2nd Ed.B.I. Churchill livingstone.
2. Chouhan S, Motor Nerve conduction studies of median nerve in young adult group. Indian Journal of Biological and Medical Research 2011, 3(2), 1751-1753.
3. Pal G.K. Textbook of Practical Physiology. 3rd Edition 2011.
4. Buschbacher RM. median Nerve motor condition to the abductor pollicis brevis Am J Pugs Med.Rehabil.1978 Nov, (6 Suppl) S1-8.
5. Flack B, Stalberg E *et al*. Clinical motor nerve conduction studies. Method in clinical nerurophysiology-1993, 4(1), 61-80.
6. Tong HC, Werner RA, Franzblan A etal. Effect of aging on motor nerve conduction study parameter. Journal of Muscle Nerve- 2004; 29; 716-20.
7. Chi-Ren=H, Wen-Nen C etal. Effect of age, gender, Height and weight on late responses and nerve conduction study parameter. Acta Neurol Taiwan.2009; 18(9) 242-249.
8. Ginzberg M, Lee M, Alba A. Median and ulnar nerve condition determination in the erb's point axilla segment in normal subject. J Neurol. Neurosurg Pshchiatry 1978 May 41 (5); 263-71.
9. Falco FJ, Hennessey WJ, Braddom RL *et al*. Standardized nerve conduction studies in the upper limb of the healthy elderly. Amj Phys Med Rehavil. 1992, 71(2), 26, (Pubmed).
10. Kimura J, Murphy MJ, Varga Vetal. Electrophysiological study of anomalous innervations of intrinsic hand muscles. Neurology 1973, 51, 1387-1427.
11. Chouhan S. Motor Nerve conduction studies of median nerve in young adult group. Indian Journal of Biological and Medical Research 2011,3(2),1751-175
12. Thakur D. Pandel B, Bajaj BK etal. Nerve conduction study in healthy individual; a gender based study. Health Renaissance Sept-Dec 2010; 8(3) 169-75.
13. Soudmand R, Ward LL *et al*. Effect of height on nerve conduction velocity.Journal of Acta Neurology-1982, 32(2), 407-410.
14. Garg R, Bansal N. *et al*. Nerve conduction studies in upper limb in the Malwa region- in normative data. Journal of Clinical Diagnosis and Research-2013,7 (2), 201-215.

****