



## Normative Values Of Nerve Conduction Parameters For Common Peroneal Nerve

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### ABSTRACT

The aim of this study is to generate normative database of nerve conduction parameters (NCP) for the common peroneal nerve (CPN) from the tibialis anterior (TA) muscle. A total of 70 healthy male and female subjects, 13-66 years of age, without risk factor for neuropathy were tested. Digital NCV/EMG machine was used to analyze the components of compound motor action potential (CMAP) that are amplitude, distal latency (DL), and conduction velocity (CV). Study was performed at 32<sup>0</sup>C room temperature. Limb Temperature was controlled by hot water bag when needed. The CPN Motor studies gave DL of 3.01 ms, Amplitude of 3.84 mv and CV of 56.26 m/sec from TA. In our study, no significant difference was seen in NCP between right and left sides, Moreover, no correlation was observed between age and NCP. This study will be helpful for our locality in establishing normative database of NCP of common peroneal nerve while recording from TA. Minimum and maximum of normal were obtained, and 25%, 50% and 75% percentile were calculated. For proposing normative value, these measurements are suitable way for Electrophysiological evaluation of the Motor CPN, which can be used as reference by the other neurophysiology labs while dealing with this nerve.

**Keywords:** Common Peroneal Nerve, Tibialis anterior, Reference value.

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## INTRODUCTION

Nerve conduction studies (NCS) and needle electromyography (EMG) play a crucial role in the assessment of patients with neuromuscular disorders. NCS and EMG tests are used to identify the disorders of the peripheral nervous system, polyneuropathies, mononeuropathies (carpal tunnel and tarsal tunnel syndromes etc), radiculopathies, and nerve injury caused by injury and compression<sup>1-3</sup>. Nerve conduction study (NCS) assesses peripheral motor and sensory functions, the motor NCS requiring stimulation of a nerve while recording from a muscle innervated by that nerve, whereas sensory NCS by stimulating a mixed nerve while recording from a mixed or cutaneous nerve<sup>4-6</sup>. These studies have been used clinically for many years to identify the site of peripheral nerve lesion in single nerve and along the length of nerves and to differentiate these from muscle diseases or neuromuscular junctions disorders<sup>4</sup>. Further, NCS can help define whether the underlying pathophysiology is due to demyelination or axonal loss<sup>3, 7-10</sup>.

The CPN is a branch of sciatic nerve that begin at the apex of popliteal fossa and on reaching fibula neck, this CPN nerve curve round the neck deep to peroneus longus<sup>11</sup>. It divide into superficial and deep peroneal nerve distal to fibular neck<sup>12</sup>.

CPN Neuropathy assessment can be done by localizing the site and nature of lesion. The conduction velocity measurement of the concern nerve in healthy subject can be used as a diagnostic tool to differentiate it from abnormal<sup>13, 14</sup>. In the region of head and neck of fibula, CPN can be damage either by compression or direct trauma<sup>14</sup>. Some of the common cause of compression are plaster casts, or from sitting with the leg crossed for pronged period<sup>13</sup>. Also after surgery of total knee replacement<sup>15</sup>, it is liable to get injured. The prognosis depend on severity of nerve damage which depend on conduction block which take lesser time as compared to axonal damage. The prognosis can be found out by NCS and normal reference value can be compared with abnormal values<sup>13</sup>.

The goals of every study of nerve disorders are to localize the lesion and to provide further information regarding the underline nerve pathophysiology. To identify the abnormality on the basis of NCS, normative data from the local population is needed. Several factors may influence the test such as temperature, age, height etc, <sup>16</sup>. They have to be taken into consideration while doing NCS.

Difficulties in calculating the motor nerve conduction velocity of the peroneal nerve arise when the extensor digitorum brevis (EDB) is completely atrophied and does not respond to stimulation. In these patients, conduction velocity in the proximal fibers of the peroneal nerve

can still be examined by recording from proximal muscle such as the tibialis anterior and peroneus brevis. The normal values of peroneal nerve from proximal muscles have been investigated by many authors to drive the normal ranges for latency, amplitude and conduction velocity<sup>17, 18</sup>. However, many studies have been published regarding normative data from western countries with cold climate condition<sup>19</sup>.

We established normal values of peroneal nerve to the tibialis anterior muscle for our warm climate locality by a simple standardized method. Commonly measured parameters of NCS include amplitude, latency and conduction velocity. The aim of this study is to measure the different parameter which can be used to identify nerve pathologies

## MATERIALS AND METHOD

Every neurophysiology lab needs to establish the normative data for its population required in clinical practice to identify nerve function abnormality. So, to provide additional reference value, this study was carried out in the neurophysiology lab of Neurology department, Civil Hospital Karachi. Seventy (70) normal healthy subjects, aged between 13-66 years were selected for Motor Nerve conduction studies of CPN to the TA. The ethical permission was taken from the committee of concern department and informed written consent for the study was taken from all the subjects.

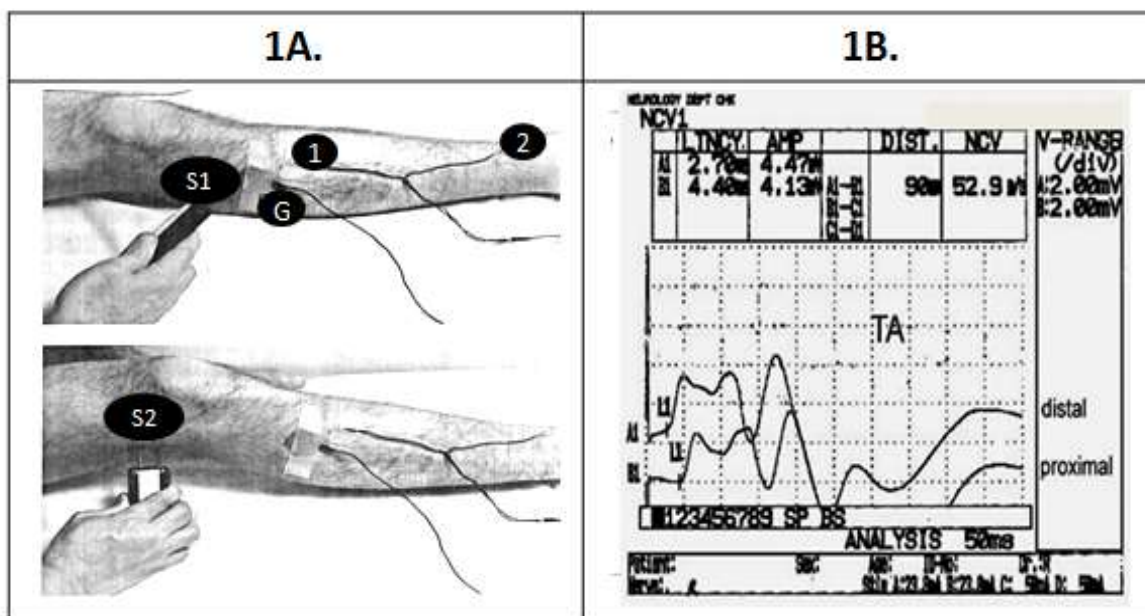
The machine used for the study was “digital Neuropack II, manufactured by Japan. This machine is generally used to diagnose and analyze the neuromuscular activities electro-physiologically. It was used in the present study for NCS. From this study, reference value of NCP specially motor conduction velocity of CPN from TA have been obtained.

Subjects were selected after taking brief history, and performed basic clinical examination to rule out any neurological deficit.

### **Nerve Conduction Study of Common Peroneal Nerve by Using Tibialis Anterior**

Active surface electrode (1) was placed over the Tibialis anterior muscle, Reference surface electrode (2) placed over the tibia and Ground surface electrode (G) placed between stimulating and recording surface electrode (Figure 1A). Before applying surface electrode, the skin was cleaned with alcohol swab. The stimulus was given to the nerve at two points with the help of stimulator. First distally (S1) approximately 2 cm distal to the fibular neck. Second, proximally (S2) in the lateral part of popliteal space. Using supramaximal stimulus, the recording of the nerve was taken.

The distance between two stimulating point were measured to calculate nerve conduction velocity (NCV) of concern segment. Latency and Amplitude were also studied and data was expressed as Mean and standard deviation S.D. A sample of motor response recorded from TA is shown in the Figure 1B.



**Figure 1A: Electrode placements [recording (1,2) , stimulating (S1,S2) and ground (G) electrodes] and B: Motor response of common peroneal nerve from tibialis anterior muscle.**

### Inclusion Criteria

Subjects who have the ability to give informed consent and have no clinical deficit were included in this study.

### Exclusion Criteria

Subjects with history of diabetes, numbness and leg trauma were excluded from the study.

## RESULTS AND DISCUSSION

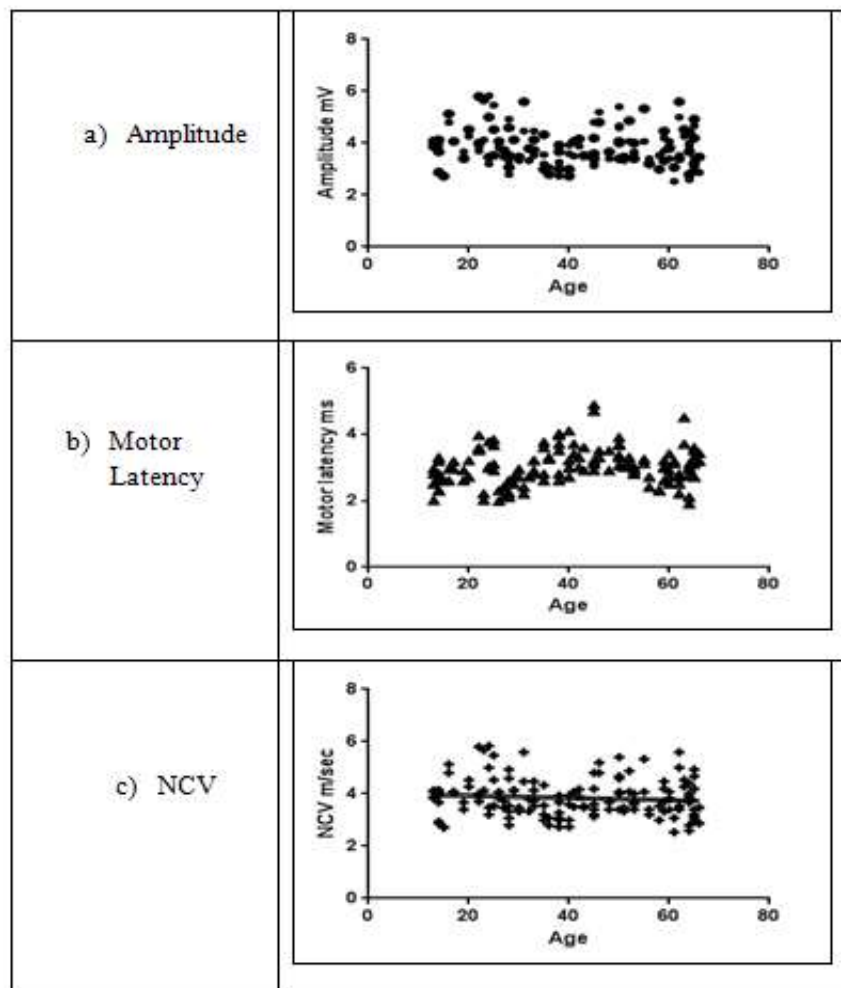
Mean, minimum, maximum, and Standard deviation (S.D) values of NCV, Motor Latency, and amplitudes of CMAP have been presented in Table 1, for common peroneal nerve, recorded from TA. The individual values of amplitude have been found to be ranged from 2.53 mV to 5.83 mV. The lowest value of latency was 1.9 msec. and highest was 4.88 msec. However, the lowest value of NCV was 45 m/sec and the highest was 75.8 m/sec.

According to the Table 1, the NCV, Motor Latency and Amplitude calculated from normal subjects demonstrated the mean values of  $56.26 \pm 0.52$  ,  $3.01 \pm 0.05$  and  $3.84 \pm 0.06$  respectively, recorded from TA.

No correlation has been observed between age and NCP as shown in Figure 2.

**Table 1. Nerve conduction parameters of common peroneal nerve.**

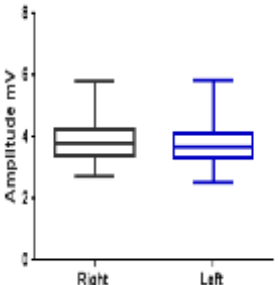
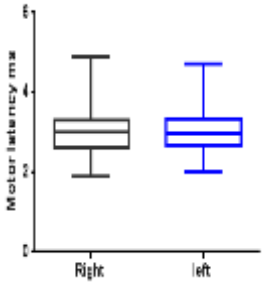
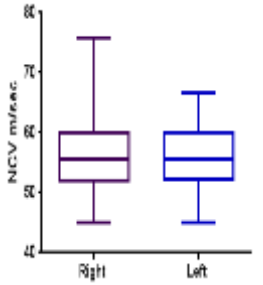
	Amplitude (mV)	Motor Latency (msec.)	Nerve Conduction Velocity (m/sec.)
Mean	3.84	3.01	56.26
Number of observations	140	140	140
Minimum	2.53	1.9	45.00
Maximum	5.83	4.88	75.80
25% percentile	3.36	2.65	52.70
50% percentile	4.18	3.39	60.40
75% percentile	5.01	4.14	68.10
Standard deviation	0.73	0.54	6.15
Standard error	0.06	0.05	0.52



**Figure 2. Correlation of nerve conduction parameters (a. Amplitude, b. Motor latency, c. NCV) with age.**

There is no significant difference in amplitude, Motor Latency and NCV of CMAP between Right and Left side as per paired 't' test, recorded from TA, shown in Table 2. From above data, a reference value of motor NCV, Amplitude and motor latency for CPN from TA were proposed, which can be used by clinician while making diagnosis.

**Table.2. Comparison of nerve conduction parameters of common peroneal nerve between Right and Left sides (Significance levels being  $P > 0.05$  as nonsignificant).**

	Amplitude (mv)		Motor Latency (msec.)		Nerve Conduction Velocity (m/sec)	
	Right	Left	Right	Left	Right	Left
Mean	3.89	3.79	2.99	3.03	56.18	56.34
Observations	70	70	70	70	70	70
Standard deviation	0.75	0.71	0.55	0.53	6.51	5.81
Standard error	0.09	0.09	0.07	0.06	0.78	0.70
t-value	0.81		0.4		0.16	
df	138		138		138	
p-value	0.419		0.689		0.873	
Comparison						
Comment	Not significant		Not significant		Not significant	

### Data Analysis

Data collected was analyzed using statistical software (Graph pad Prism6 and MS Excel 2007). The comparison between two groups was done by paired "t" test and a significance levels being  $P > 0.05$  as nonsignificant and correlation was tested between age and NCP.

Over the year NCS/EMG has been used as a simple noninvasive technique for diagnosis, monitoring and prognostic evaluation of nerve injury and neuropathy<sup>1-4, 20</sup>. NCS reference values are used to define the limits of normal function<sup>1, 4, 17-19</sup>, with test values outside the range suggesting the presence of some form of neuropathy. The normative data of motor latency, amplitude of compound muscle action potential and nerve conduction velocity recorded from EDB & TA have already been reported with slight differences in the values obtained in different labs<sup>20-22</sup>. The EDB is commonly used to record action potential on peroneal nerve<sup>23, 24</sup>. On the other hand, peroneal motor studies from the tibialis anterior muscle are not routinely performed

in electro-diagnosis. It is more often used to confirm the peroneal nerve compression across the knee<sup>18, 25, 26</sup>. It is also used to confirm the neuropathy either axonal or demyelinating type<sup>6</sup>. The normative data of nerve conduction parameters i.e., Motor Latency, CMAP amplitude and Nerve conduction velocity, for peroneal and other nerves of lower limb was also proposed<sup>6, 22, 27</sup>. For NCS of any nerve, reference values should be established from the local population because previous studies have shown differences in NCS function related to ethnicity and demographic factors<sup>21, 28</sup>. In our study, we have evaluated the NCS parameters of common peroneal nerve in healthy subjects to obtain the reference value for our laboratory. These can be used for evaluation of nerve injury.

It has been assumed that the conduction velocity remains relatively static throughout the adult years but has a tendency to decrease slightly as an individual age.

More commonly, tables of normal control values provide a range of nerve conduction velocities, usually for subjects between ages 10 and 60 that take into account the normal variability within that age range<sup>6</sup>. The relationship of conduction velocity to age is most dramatically seen in individuals younger than age 4 and older than 60. Conduction velocities begin to decline at about age 40 years, but the decrease is less than 10 m/sec by the 80th year<sup>29</sup>.

Some of the study showed relationship between NCS parameters and age<sup>30, 31</sup>. Whereas in other studies, no significance difference has been reported statistically for NCV and amplitude regarding age (10-65 years), and also between right and left limb<sup>19, 32, 33</sup>.

In our study, we also observed no significant correlation between the age and NCP and also no significance was seen between the right and left side in relation to any of the NCP taken into consideration in this study.

## CONCLUSION

Our result of normative value of NCP of peroneal nerve to the TA may be used as preliminary working reference in our locality while making a decision regarding diagnosis and progress of the nerve injury concern.

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