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Measurement of nerve conduction study in a sample of healthy Iraqi: Normative data

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Abstract: *Electrophysiological study (nerve conduction study"NCS") is useful adjunct test to the medical history and clinical examination in the diagnosis of such complication, early detection and differentiation of type of peripheral neuropathy. The aims of this study are designed to Decide the most necessary parameters of NCS of healthy subjects to establish the normal electrophysiological values of the common nerves in upper and lower limb .The present study was carried out at the neurophysiology unit in Al-yarmouk Teaching Hospital.The study group consists of eighty six (86) healthy volunteers (45 males and 41 females). The age of this group ranged between 20 to 75 years with a mean (52.48 ±10.63) years. All subjects were healthy and symptoms free, with no history of systemic and neurological diseases. No history of alcohol abuse or drug intake. They compromised normal relatives, medical staff, students and workers. All of 86 subjects that were included in this study were informed about the aim and technique of the study and their acceptance was taken. Each subject was submitted to medical history and electrophysiological tests (NCS) of the two limbs i.e. the upper and the lower. These tests include Sensory nerve conducting study (SNCS) for Median, Ulner and Sural nerves and Motor nerve conducting study (MNCS) for Median, Ulnar, Fibular (Common peroneal), and tibialnerves. The results showed data were processing separately between males and females with mean accompanying with standard deviation for sensory and motor of median, ulnar sural, common peroneal and tibialnerves. Conclusion: The study will be helpful normative parameters of the common tested nerves of the upper and lower limbs were established for the EMG laboratory in our region.*

Keywords: *Iraqis, Lower limbs, Nerves Conduction study, Upper limbs*

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I. Introduction

The NCS tests are typical for the diagnosis of large fiber polyneuropathy .Their usefulness are to Recognize which type of fiber involved ("motor versus sensory") ,Determine the neuropathy severity ,Detect "the distribution of neuropathic dysfunction" (proximal or distal, focal, multifocal or generalized) also Can verify the close amount of axonopathy versus myelinopathy (uniform or patchy demyelination). However, the ultimate electrodiagnosis can only be achieved when the whole prototypes of NCS-EMG result is processed and then perceived with knowledge of the clinical history and examination [1].

Sensory nerve conduction study:
The "sensory nerve action potential (SNAP)", is the amount of the accomplishment of potentials created by the myelinated axons of the sensory nerve". The major constituents of "the SNAP are generated by fast conducting A (alpha) fibers with diameters exceeding 9 μm and conductive velocity CV between 40 and 65 m/s in the upper and lower extremities [2 and 3].The parameters of sensory nerve conduction study include:

1-Latency:
The latency of SNAP allude to the time exerted to the stimulate moving from the stimulation site to the recording site. Latency is calculated to the onset of the negativity, regardless of whether there is an initial positivity [4]. Latency to the onset reflects conduction in the fastest fibers and is used to calculate conduction velocity, this is called onset latency [5].

2-Amplitude:
The amplitude of SNAP is detected from the peak of the positive deflection to the peak of the negative deflection (peak to peak), it is measured in microvolts (μv). The amplitude relys on the amount of stimulated axons "and the synchrony with which they transmit their impulse[4]

3- Conductive velocity:
Represents the space between the stimulation site and that of recording, over the time between stimulation and the arrival of the action potentials at the recording site[6].In sensory studies, the velocity of conduction can be

measured by a single stimulation because there is no transmission along the neuromuscular junction or muscle fibers [7]

Sensory nerve conduction velocity (SNCV) (m/sec.) is calculated as follows [4]:

$$\textbf{SNCV (m/sec.)} = \frac{d}{t}$$

Where are:
d= Distance (mm) between active electrode and stimulation sites
t=Sensory latency (msec.).

Motor nerve conduction study:

The evoked motor response is called "a compound muscle action potential (CMAP)" because it is considered as the amount of the potential performance of the individual muscle fiber, which in effect is biphasic with an initial negative deviation (by convention, negative is upward from the baseline and positive is downward) and portraits the outlined potentials of all essential individual muscle fiber.

When supramaximal stimulation conducted on the motor nerve, it motivates all motor axons in the nerve. The potential performance are applied to" the muscle and the individual motor unit potentials summate to form the compound muscle action potential (CMAP), it is also referred to as the Mwave "M" standing for motor" [8].

The usual parameters that can be measured in motor NCS are:

1- Distal motor latency (DML) :

The distal latency represents the exerted time from the stimulus to the inception of the M-wave. We can simply propose that the DML is constituted from: (1) the consumption of time at the stimulus site for the creation of the nerve action potentials, (2) "the conduction time (CT) from the stimulus site to the end plates of the fastest motor alpha axons, (3) the neuro-muscular transmission time, and 4) the time taken for the action potentials of the muscle fibers to travel from the end plate to the recording electrode". Most of the DML time" consists of the time taken to propagate along the nerve to the stimulus site" [3].

2- "Conduction velocity":

This means the calculated amount of the nerve conduction speed and is measured in meters per second (m/s). Motor conduction velocity reflects the pure speed of the largest motor axon and, in contrast to distal and proximal latencies, does not include any neuromuscular transmission time nor propagation time along the muscle membrane. Motor nerve conduction velocity (MNCV) (m/sec.) in the motor fibers is calculated as follows [4]:

$$\text{MNCV (m/sec.)} = \frac{d}{t1-t2}$$

Where:
d= Distance (mm) between "proximal and distal stimulation sites"
t1 = "Proximal latency" (msec.)
t2 =" Distal latency" (msec.)

1- "CMAP area":

This area is habitually restricted to the negative phase area beneath the wave form and exhibits linear connection with the product of the amplitude and period of CMAP. It is measured in (mV msec.). The capability to quantify CMAP area has almost replaced the need to measure its duration since the duration is incorporated in the area calculation [9].

2- CMAP duration:

It is calculated from beginning of first negative untill the subsequent positive crossing of the baseline, measured in milliseconds [6].

3- The amplitude of CMAP :

It is determined as the maximum peak-to-peak amplitude and is expressed in millivolts (mV). However, it reflects the amount of the potential action created by individual muscle fibers strengthened by the motor axons that are stimulated [10 and 3]. CMAP amplitude represents a semi quantitative calculate of the digit of conducting axons in the midst of both the stimulating and the recording points. It depends on the "relative conduction speed of the axons, the integrity of the neuromuscular junctions, and number of muscle fibers that are able to generate action potentials" [9].

II. Subjects and methods

The control group consists of eighty six (86) healthy volunteers (distributed as forty five (45) males and only forty one (41) females). As for the age of the control group ranged between 20 to 75 years and a mean of (52.48 ±10.63) years. 22-75 years for males with a mean of age (53.54± 14.57) years, and 20-74 years for females with a mean of age (51.42 ±11.91) years. All subjects were healthy and symptoms free, with no history

of systemic and neurological diseases. No history of alcohol abuse or drug intake. They compromised normal relatives, medical staff, students and workers.
In this study the following electrophysiological tests were considered:
(1) "Sensory nerve conduction of right, left median, right, left ulnar and right sural nerves".
(2) "Motor nerve conduction and F-wave studies of right , left median; right ulnar" ; right , left fibular (common peroneal) and right tibial nerves.
The room temperature was monitored between (25C°- 28 C°) during the test procedures and skin temperature between (36C° to 37C°) with a mean of 36.7C° was measured by using a skin thermometer.
The EMG machine:Cadwell Sierra Wave, Version 11.0.116 EMG system was used for recording and "analysis of sensory, motor nerve conduction parameters and" muscle activities. This system includes four channels preamplifiers. Stimulus intensity can be manually adjusted (1-99 mA), and the elicited reactions can be demonstrated on the screen, the matter that enables the four channels to be displayed at the equivalent time. A thermal printer connected with a device to get stable recording of the exhibited signals are used to obtain the printed results. The device includes an audio amplifier, the audio amplification throughout needle examination assists in the identification of muscle impending by their sounds characteristics. Throughout the study of nerve conduction, the associated auditory monitor assist to confine the site of the nerves stimulation.

The "electrodes" :

A- "Grounding electrode":

A "surface-grounding electrode" was utilized to defend the participants adjacent to electrical hazard and to decrease the artifacts and the interference. "The electrode" is placed between a stimulating and recording electrode with special paste and fixed with plaster, to guarantee fine "electrical conduction" .

B-" Stimulating Electrodes":

In order to motivate motor and sensory nerves (antidromically) throughout the skin a bipolar surface stimulating electrode was utilized. The electrode contains two felt tips raised in the "stainless steel holders in a plastic frame". The felt tips were flooded in normal saline just before use to make certain good conduction.

C- Recording "electrodes":

Surface electrodes:

a) a "Bipolar surface" recording electrode was used for "median ,ulnar, common peroneal and tibial motor nerves" for recording the elicited "compound muscle action potential (CMAP) parameters (amplitude and duration) in order to detect evidence of conduction block and abnormal temporal dispersion". This same electrode was used to recording sensory action potential from sural nerve.

b) Two Velecro ribbons electrodes were used for "median and ulnar sensory nerves stimulation", the black ring is the cathode which was attached proximally and the red ring is the anode which was attached distally to the tested finger.

Procedure:

Sensory nerve conduction study:

For the sensory potential, surface stimulation and recording technique was used. The stimulus intensity was 20-30% above the current necessary to evoke a maximal sensory nerve action potential. The supramaximal stimulating current was kept beneath entrance for "motor fibers" especially in mixed nerves, since "sensory fibers" generally, have lesser entrance of motivation than that of motor fibers. The parameters studied in sensory conduction include:

1. The sensory latency.
2. Amplitude.
3. "Sensory nerve conduction velocity".

The sensory latency was measured in milliseconds (msec.) from onset of the stimulus to the preliminary of "sensory nerve action potential (SNAP)". The amplitude was calculated in microvolts (μV.) from one peak to another .

The "sensory nerve conduction velocity (SNCV)" (m/sec) was measured through separating the conduction space in millimeters (measured by a flexible tape measure) by the sensory latency in milliseconds [4]:

SNCV (m/sec.) = $\frac{d}{t}$

Where are:
d= Distance (mm) between active electrode and stimulation sites
t=Sensory latency (msec.).

Meaningful comparisons of the sensory latency require strict standardization of the distance. So the distance between stimulation and recording electrodes was standardized for sensory study (median nerve; 14cm) (ulnar nerve; 12cm) (sural nerve; 14cm).
The majority of "supramaximal sensory responses were electronically averaged over 10-100 stimulus repetitions".
The electromyographic setting was: Frequency: 100 HZ – 10KHZ.
Sweep speed: 2 msec / Division.
Sensitivity: 5µ v / Division.
The sites of the electrodes for sensory nerve conduction study for the tested nerves as follows:

The Median Nerve:

Recording: Recording electrode was applied with finger electrodes, around the index with the cathode (black ring) next to the index's base. Ground: The place of the ground electrode is situated between the recording and stimulating electrodes.
Stimulation: The stimulating electrode was situated above the "median nerve at the wrist between the tendons of palmaris longus and flexor carpi radials". The cathode was placed distally, 14cm from the active ring electrode.

"The Ulnar Nerve":

Recording: recording was applied with finger surface electrodes, around the fifth digit with the cathode (black ring) next to the index's base. Ground: The place of the ground electrode is situated between the recording and stimulating electrodes.
Stimulation: the stimulating electrode was situated above the "ulnar nerve at the wrist, just radial to" the flexor carpi ulnaris. The cathode was placed distally, 12cm from the active ring electrode .

The Sural Nerve:

Surface recording of the sural nerve was performed, utilizing "surface electrodes for stimulation and recording of the sensory action potential". Recording: "The surface recording electrodes was placed posterior and below the lateral malleolus of the fibula".
Ground: The ground was situated between the recording and stimulating electrodes.
Stimulation: "The surface stimulating electrode was placed lateral to the mid-line of the calf (14) cm proximal to the active electrode".

Motor Nerve Conduction Study:

A study of motor nerve conduction revealed that the nerve was motivated at two points by the side of its course, by applying stimuli at distal and proximal sites of the "nerve and recording from the muscle innervated by that nerve". The stimulus intensity must be high enough to activate all nerve fibers during stimulation. The use of 20-30% supramaximal intensity in which the recorded action potential no further increases with the increase in stimulus intensity. A bipolar surface simulating electrode (for adult, with a stimulation electrode strap) was used for stimulating the motor nerves. The parameters in motor nerve conduction study include:

1. "Distal motor latency".
2." Motor nerve conduction velocity".
4. Duration.
5. Amplitude.

For studying the "distal motor latency, nerve conduction velocity and F-wave latency", concentric needle electrode was used as a recording electrode, and for studying duration and amplitude of the CMAP, "a pair of surface electrodes" was used as recording electrodes.
The electromyographic setting was:
Frequency: 100 – 500 HZ.
Sweep speed: 5 m sec / Division.
Sensitivity: 200 µV / Division.
Distal motor latency is the time calculated from the beginning of the distal stimulus artefact to the beginning of the negative response. "Motor nerve conduction velocity was measured by supramaximal stimulation of the nerve at two points and recording the compound action potentials from the same innervated muscle which must be similar in configuration". The "conduction velocity can be thus measured as follows" [4]:

MNCV (m/sec.) = $\frac{d}{t1-t2}$

Where:
d= Distance (mm) between "proximal and distal stimulation sites"
t1 = "Proximal latency" (msec.)
t2 = "Distal latency" (msec.)

The median nerve:
Recording: two disposable surface electrodes were used, "the active surface electrode" that was situated above the prominence of "abductor policies brevis, between the metacarpophalangeal joint of the thumb and the midpoint of the distal wrist crease. The reference electrode was placed over the distal phalanx of the thumb".
Ground: the grounding electrode was placed between the stimulating and recording electrodes.
Stimulation: it was performed at two sites using a bipolar surface stimulating electrode:
a. Distally:
It is situated "at the wrist, 8 cm proximal to the active recording electrode, over the skin" between palmaris longus and flexor carpi radials tendons.
b. Proximally:
At the elbow, "in the median aspect of the anticubital space, just lateral to the brachial artery".

The ulnar nerve:
Recording: the active surface electrode was situated at the abductor digitiminimi, on a position "mid-way between the distal wrist creases and the crease at the base of the fifth digit. The reference electrode was distally at the base of the fifth digit".
Ground: the grounding electrode was placed "between the stimulating and recording electrodes".
Stimulation: was performed at two sites using a "bipolar surface stimulating electrode":
a. Distally:
At the wrist, 8 cm proximal to the active recording electrode, and just over the flexor carpi ulnaris tendon.
b. Proximally:
At the elbow just distal to the ulnar groove.

The Common Peroneal Nerve:
"Common Peroneal Nerve to the extensor digitorum brevis muscle" (EDB):
Recording: We can recognize the active surface electrode just above "the extensor digitorum brevis muscle. The reference electrode was placed 3-4 cm distal to the active electrode"
Ground: The grounding electrode was placed between the stimulating and recording electrodes.
Stimulation: was performed at two sites using a bipolar surface stimulating electrode:
a. Distally: as for the ankle, "8 cm proximal to the active recording electrode", proximal to the lateral malleolus.
b. Proximally: at the knee, just below the head of fibula (capitulum fibulae).
Common Peroneal Nerve to Tibialis Anterior Muscle :
Recording: Disposable concentric "needle electrode was inserted" in the tibialis anterior muscle "at the junction of the upper third and lower" two third of a line between the tibial tuberosity and "the tip of the lateral malleolus of the fibula ".
Ground: The ground "electrode was placed between the stimulating and recording electrodes Stimulation": at the knee, just below the head of fibula (capitulum fibulae).

The Tibial Nerve:
TibialNerve to the Abductor Hallucis "muscle :
Recording: The active surface electrode was placed 1 cm below and 1 cm behind the navicular tubercle on the medial side of the foot", above the Abductor Hallucis muscle. The "reference electrode" was situated distally above the metatarsal-phalangeal joint of the big toe .
Ground: "The ground electrode was placed between the stimulating" and recording electrodes .
Stimulation: was "performed using a bipolar surface stimulating electrode", applied at the :
A-Distally (at ankle): Stimulating cathode is placed posterior and just proximal to the medial malleolus, "halfway between the medial malleolus and Achilles tendon" .
B-Proximally (at knee): Stimulating slightly lateral to the halfway "point of the popliteal fossa along the popliteal crease".
Tibial nerve to the medial Gastrocnemius muscle :
Recording: Disposable concentric "needle electrode was inserted in the medial gastrocnemius muscle"; one hand breadth below the popliteal crease "on the medial mass of the calf".
Ground: "The ground electrode was placed between the stimulating and recording electrodes".
Stimulation: was performed using a bipolar surface "stimulating electrode, applied at the knee slightly lateral to the halfway point of the popliteal fossa along the popliteal crease".

Statistical Analysis
The Statistical Package for the Social Sciences, (SPSS version 25 for windows, SPSS Inc., Chicago, Illinois) and computerized Program and Microsoft Excel program were utilized for all data manipulation and analyses.

Categorical variables were presented as frequency and percentage, "Chi-square was used to test the significance of association between categorical variables".
The level of statistical significance was defined as P value <0.05, which was obtained by comparing the calculated t-value to the tabulated t-value at 95% confidence interval.

III. Results

Table (1) Comparison of sensory parameters between males and females in the studied group.

Parameter	**Male (mean±SD)**	**Female (mean±SD)**	**P- value**
median nerve			
Distal latency(msec.)	**2.46 ± 0.307**	**2.52 ± 0.305**	**0.3715**
SNAP amplitude (µV)	**33.39 ± 5.36**	**34.45 ± 4.33**	**0.3217**
SNCV (m/sec.)	**56.10 ± 6.21**	**56.12 ± 6.06**	**0.9881**
ulnar nerve			
Distal latency(msec.)	**2.87 ± 0.179**	**2.91 ± 0.219**	**0.3621**
SNAP amplitude (µV)	**25.76 ± 2.079**	**26.47 ± 1.363**	**0.0678**
SNCV (m/sec.)	**52.64 ± 3.35**	**51.33 ± 3.409**	**0.0794**
sural nerve			
Distal latency(msec.)	**2.24 ±0.487**	**2.43±0.861**	**0.2168**
SNAP amplitude (µV)	**14.45 ± 3.55**	**15.31 ± 3.62**	**0.2749**
SNCV (m/sec.)	**50.94 ± 17.61**	**48.04 ± 6.30**	**0.3179**

Table (2) Comparison of the motor parameters of the upper limbsbetween males andfemales inthestudied group.

Parameter	**Male (mean±SD)**	**Female (mean±SD)**	**P- value**
Right median nerve			
Distal latency(msec.)	**2.86 ± 0.141**	**3.01 ± 0.403**	**0.1110**
MNCV (m/sec.)	**59.52 ± 2.74**	**57.49 ± 7.24**	**0.2283**
Distal amplitude. (µV)	**11.99 ± 0.589**	**11.66 ± 0.456**	**0.0506**
Right ulnar nerve			
Distal latency(msec.)	**2.49 ± 0.304**	**2.63 ± 0.333**	**0.1621**
MNCV (m/sec.)	**62.39 ± 4.87**	**60.08 ± 3.86**	**0.0984**
Distal amplitude. (µV)	**11.64 ± 0.80**	**11.75 ± 0.40**	**0.5822**

Table (3) Comparison of the motor parameters of the lower limbs between males and females in the studied group.

Parameter	**Male (mean±SD)**	**Female (mean±SD)**	**P- value**
Peroneal nerve			
Distal latency(msec.)	**3.96 ± 0.14**	**4.10 ± 0.40**	**0.1332**
MNCV (m/sec.)	**53.06 ± 1.80**	**51.60 ± 4.82**	**0.1960**
Distal amplitude. (µV)	**5.43 ± 0.84**	**5.45 ± 1.21**	**0.9503**
Tibial nerve			
Distal latency(msec.)	**4.45 ± 0.24**	**4.59 ± 0.38**	**0.1573**
MNCV (m/sec.)	**45.50 ± 2.47**	**44.03 ± 3.69**	**0.1339**
Distal amplitude. (µV)	**6.25 ± 0.74**	**6.01 ± 0.76**	**0.3063**

Table (4) the value ranges of the sensory parameters of males in the studied group.

Parameter	Male sensory	
	Min. – Max.	(mean ±SD)
median nerve		
Distal latency(msec.)	1.85 – 3.01	**2.46 ± 0.307**
SNAP amplitude (µV)	26.90 – 47.12	**33.39 ± 5.36**
SNCV (m/sec.)	46.51 - 70	**56.10 ± 6.21**
Ulnar nerve		
Distal latency(msec.)	2.05 – 3.27	**2.87 ± 0.179**
SNAP amplitude (µV)	23.12 – 32.54	**25.76 ± 2.079**
SNCV (m/sec.)	50.73 – 58.52	**52.64 ± 3.35**
sural nerve		
Distal latency(msec.)	1.31 – 2.92	**2.24 ±0.487**
SNAP amplitude (µV)	9.75 – 16.10	**14.45 ± 3.55**
SNCV (m/sec.)	45.36 – 57.61	**50.94 ± 17.61**

Table (5) the value ranges of the motor parameters of males in the studied group.

Parameter	Male motor	
	Min. – Max.	(mean ±SD)
median nerve		
Distal latency(msec.)	2.37 – 4.3	**2.86 ± 0.141**
Distal amplitude. (µV)	7.23 – 16.81	**59.52 ± 2.74**
MNCV (m/sec.)	47.91 – 76.12	**11.99 ± 0.589**
Ulnar nerve		
Distal latency(msec.)	1.85 – 3.59	**2.49 ± 0.304**
Distal amplitude. (µV)	6.58 – 17.01	**62.39 ± 4.87**
MNCV (m/sec.)	48.23 – 77.35	**11.64 ± 0.80**
Common peroneal nerve		
Distal latency(msec.)	2.08 – 4.59	**3.96 ± 0.14**
Distal amplitude. (µV)	4.68 – 9.21	**53.06 ± 1.80**
MNCV (m/sec.)	42.16 – 58.03	**5.43 ± 0.84**
Tibial nerve		
Distal latency(msec.)	3.86– 5.64	**0.1573**
Distal amplitude. (µV)	3.41 – 9.72	**0.1339**
MNCV (m/sec.)	40.78 – 54.22	**0.3063**

Table (6) the value ranges of the sensory parameters of Females in the studied group.

Parameter	Female sensory	
	Min. – Max.	(mean ±SD)
median nerve		
Distal latency(msec.)	1.71 – 3.27	**2.52 ± 0.305**
SNAP amplitude (µV)	25.64 – 48.19	**34.45 ± 4.33**
SNCV (m/sec.)	45.97 – 71.43	**56.12 ± 6.06**
Ulnar nerve		
Distal latency(msec.)	2.14 – 3.21	**2.91 ± 0.219**
SNAP amplitude (µV)	24.07 – 32.92	**26.47 ± 1.363**
SNCV (m/sec.)	50.26 – 57.61	**51.33 ± 3.409**
sural nerve		
Distal latency(msec.)	1.45 – 2.87	**2.43±0.861**
SNAP amplitude (µV)	9.62– 18.04	**15.31 ± 3.62**
SNCV (m/sec.)	41.36 – 57.54	**48.04 ± 6.30**

Table (7) the value ranges of the motor parameters of Females in the studied group.

Parameter	Female motor	
	Min. – Max.	(mean ±SD)
median nerve		
Distal latency(msec.)	2.4 – 4.52	**3.01 ± 0.403**
Distal amplitude. (μV)	7.23 – 16.81	**57.49 ± 7.24**
MNCV (m/sec.)	46.89 – 74.06	**11.66 ± 0.456**
Ulnar nerve		
Distal latency(msec.)	1.76 – 3.61	**2.63 ± 0.333**
Distal amplitude. (μV)	6.47 – 17.32	**60.08 ± 3.86**
MNCV (m/sec.)	48.53 – 77.21	**11.75 ± 0.40**
Common peroneal nerve		
Distal latency(msec.)	2.15 – 4.67	**4.10 ± 0.40**
Distal amplitude. (μV)	4.62 – 9.39	**51.60 ± 4.82**
MNCV (m/sec.)	42.30 – 58.16	**5.45 ± 1.21**
Tibial nerve		
Distal latency(msec.)	3.34– 5.87	**4.59 ± 0.38**
Distal amplitude. (μV)	3.51 – 9.64	**44.03 ± 3.69**
MNCV (m/sec.)	40.62 – 54.08	**6.01 ± 0.76**

IV. Discussion

electrodiagnostic techniques are extremely valuable in helping to define the underlying pathophysiologic process; whether axonal or demyelinating, distribution (focal, multifocal or generalized) and the functional subtypes of the nerves involved (motor, sensory, large - fiber sensory, small-fiber sensory or autonomic) [11].

This prospective study was performed to assess commonly tested peripheral nerves using electrophysiological tests (NCS). Concerning the data of examined nerves, SNAPA, SNCV, MCNV, and CMAPA values were agree to those encountered by Kimura. [12], Buschbacher [13],Karagoz et al. [14],DiBenedetto [15].

V. Conclusion

The study will be helpful normative parameters of the common tested nerves of the upper and lower limbs were established for the EMG laboratory in our region.

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