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Sural sensory conduction parameters: A study on healthy young adults

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Abstract
Background: Sural nerve is the sensory nerve most superficially present in the lower limb reflects the peripheral nerve status in length dependant peripheral neuropathy. Most nerve dysfunctions starts from the sensory nerves of lower limb. Hence sural nerve sensory parameters provide highest degree of sensitivity to diagnose peripheral nerve disease. Therefore this study was proposed to provide healthy reference values of sural sensory parameters.
Material and method: The study was conducted in 68 healthy young adults including both male and female, with proper ethical approval. After taking consent from each subject, nerve conduction study (NCS) was carried out in both lower limbs. Supra maximal stimulus was applied to obtain sensory nerve action potential (SNAP) with least artifact. Onset latency, amplitude and conduction velocity was analyzed for data analysis. Statistical software SPSS 16 version was used to analyze the data.
Result: This study suggested that the latency was increased in older age group while conduction velocity was decreased in comparison to younger age group. There was negative correlation between age and conduction velocity. There was no significant variation of amplitude in different age groups. Female subjects onset latency was prolonged and conduction velocity was low than male. There was no sex variation of amplitude.
Conclusion: This study suggested that there age and sex has significant impact on sural nerve conduction. Therefore the reference data suggested in this study may be helpful for clinicians to assess the status of peripheral nerves.

Keywords: Sural nerve, amplitude, conduction velocity, latency, peripheral neuropathy

Introduction
Among the peripheral nerves sural nerve is the most superficial nerve and placed distally for which it is easy to access nerve conduction study. Sural nerve is less prone to compressive injury [1]. Being the distal nerve it reflects the peripheral nerve status in length dependant peripheral neuropathy conditions [2]. NCS is the electrophysiological tests, able to assess the physiological status of nerves as well as to diagnose the pathology. Therefore NCS obtain certain information which helps the physicians to diagnose the disease as well as the prognosis [3-6]. Nerve conduction test is helpful in evaluation of diabetic polyneuropathy and other length dependent peripheral neuropathies [7-9]. Some studies suggested that most nerve dysfunctions starts from lower limb sensory nerves. So to assess the sensory conduction, it is wise and mandatory lower limb nerve conduction tests to get a clue towards the diagnosis [10-11]. Therefore sural sensory parameters provides highest degree of sensitivity for the diagnosis of peripheral nerve diseases [11]. Bilateral absence or low amplitude of sural sensory nerve action potential is a suggestion of involvement of nerve at peripheral level [2]. Incorrect technique, excess adipose tissue, limb edema, absence of age and sex variations reference data may lead to wrong reporting of normal NCS.
After a lot of review of literatures we found that most of studies regarding sural nerve are done in western countries. Very few studies are done in India; among them most studies have ignored the importance of age and sex variations. Therefore this study was proposed to evaluate the normal variation of sural sensory conduction parameters owing to age and sex variations.

Material and Method

This cross sectional study was conducted in department of Neurology in a health research institute of eastern India. The study was completed between July 2017 and April 2018 and was approved by institutional ethical committee. The study included 68 healthy volunteers of age range of 20 to 60 years including both male and female. Informed written consent was taken from each subject before subjected to test procedures. Selection of subjects was done on collection of data by face to face interview. Persons who are assessed healthy by personal interview were subjected to vibration sensation tests. Apparently healthy persons with intact vibration sensation of great toe were selected for the study. Persons having history of polyneuropathy symptoms like numbness, tingling, diabetes mellitus, tuberculosis, family history of peripheral neuropathy, alcoholism, smoking, medications were excluded.

The procedure of nerve conduction was clearly understood to the subjects. The tests for nerve conduction were done by the machine Neurosteim Medicaid in department of neurology. The settings of the machine were as follows: Low frequency filter was at 20 Hz, High frequency filter was 2 kHz, sweep speed of 1 ms/ division, and gain of 20 microvolt (μV)/division. Temperature of lower limb was recorded at the lateral malleolus and maintained at 30°C. All tests were done by neurophysiologists trained at the same center using the same protocol for each study. The patient was placed in a comfortable lateral decubitus with the leg to be assessed on the top. Prior to test the recording and stimulating sites were cleaned with rectified spirit to ensure maximum electrical conductance. Surface electrodes of 10 mm circular disc plates were used to record the potential. The active recording electrode was placed just behind the upper border of lateral malleolus and the reference electrode was placed 4 cm distal to it. The recording sites were marked at distances of 14 cm proximal to the active electrode. The ground electrode was then placed between the stimulating and recording sites. A supra maximal stimulus was used to obtain the maximum amplitude sural SNAP with the least stimulus artifact. The stimulating electrode was moved slowly from the midline of the calf laterally or medially till a maximum SNAP was obtained at site of stimulation. Care was taken to reduce the stimulus artifact by relative rotation of the anode or reduction of stimulus intensity, without altering the amplitude of the response. Each optimal SNAP was then averaged for at least 8-10 responses to ensure a clear onset from the baseline. The stimulus pulse duration was increased from the standard 0.1 ms to 0.2 ms in case the subjects had large calves, in the obese subjects or subjects with edema feet. For each averaged SNAP, the onset latency was measured in ms and the negative-to-positive peak amplitude was measured in μV and conduction velocity was estimated as m/sec.

For analysis of data subjects were classified into different groups based on age and sex. On the basis of age we classified subjects into four groups as follows: 20-30 years, 31-40 years, 41-50 years and 51-60 years. On the basis of sex subjects were classified into male and female.

Statistical analysis of data was done by software SPSS 16. Statistical tests applied in this study were one way ANOVA, unpaired t test and Pearson correlation. Graphs and tables were generated by Microsoft excel and word. P value less than 0.05 was considered to be significant.

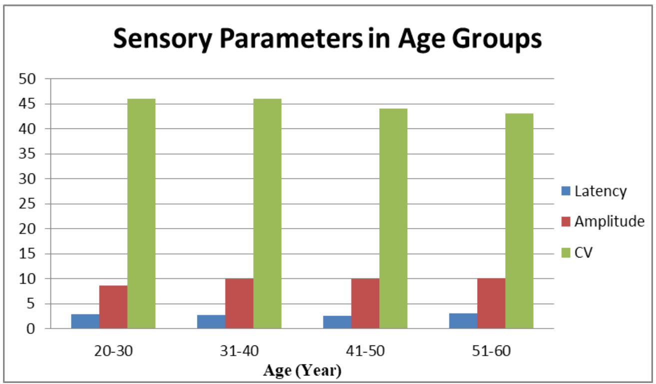
Result

Table 1 and figure 1 depicts the comparison of variables in different age groups. Onset latency of sural nerve action potential (SNAP) shows that in older age group subjects the latency is more in comparison to younger subjects significantly (p=0.005). There is no significant variations in amplitude among different age groups (p=0.145). The conduction velocity gradually decreases with increasing age significantly (p=0.041) the lowest is of older age group.

Table 1: Sensory Parameters of Different Age Groups

Variables	20-30(n=14) (Mean±SD)	31-40 (n=18) (Mean±SD)	41-50 (n=12) (Mean±SD)	51-60 (n=24) (Mean±SD)	p
Latency	2.95±0.26	2.78±0.25	2.53±0.47	3.05±0.52	0.005
Amplitude	8.61±2.14	9.90±1.78	9.98±2.36	10.17±2.01	0.145
CV	46±2.98	46±2.79	44±2.28	43±3.62	0.041

Data expressed in mean and SD form. n=no of subjects, SD=standard deviation. CV=Conduction velocity. *P*<0.05 is considered to be significant



Latency (ms), Amplitude (μV), CV (m/sec)

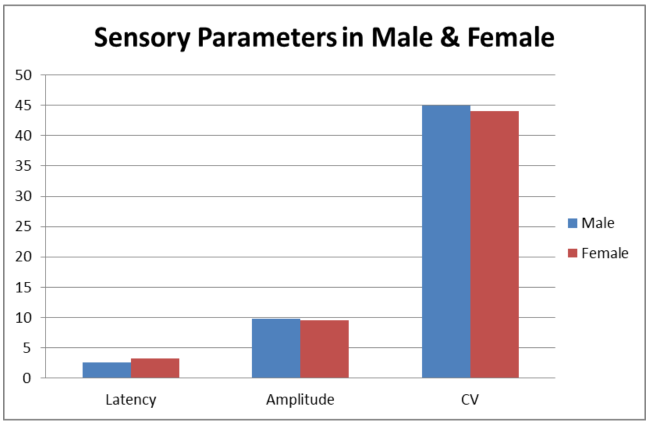
Fig 1

Table 2 and figure 2 depict the comparison of variables between male and female. Onset latency of female subjects is more than female at significant level (p=0.000). There is no significant difference in amplitude between male and female (p=0.505). There is significantly low conduction velocity in female than male (p=0.022).

Table 2: Sensory Parameters of Male and Female

Variables	Male(n=40) (Mean±SD)	Female (n=28) (Mean±SD)	p
Latency	2.58±0.29	3.28±0.25	0.000
Amplitude	9.8±1.90	9.5±2.33	0.505
CV	45±3.11	44±3.09	0.022

Data expressed in mean and SD form. n=no of subjects, SD=standard deviation. CV=Conduction velocity. *P*<0.05 is considered to be significant



Latency (ms), Amplitude (µV), CV (m/sec)

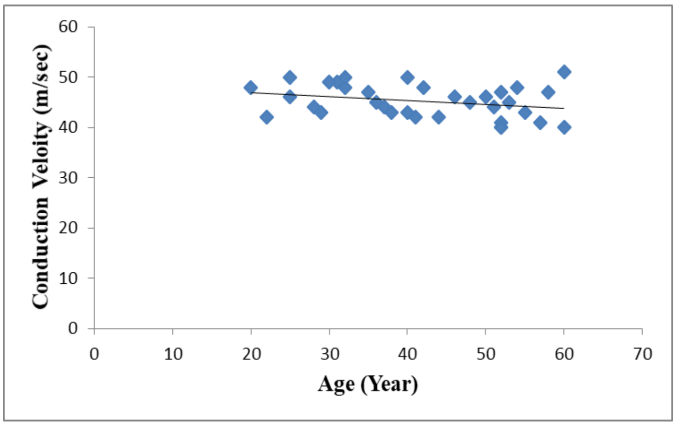
Fig 2

Table 3 depicts the correlation between age and different variables. There is no significant correlation of age with onset latency and amplitude but there is negative correlation between conduction velocity and age at significant level as shown in figure 3 (p=0.016).

Table 3: Correlation between Sensory Parameters and Age

Variables	r	p
Age-Latency	0.047	0.704
Age-Amplitude	0.194	0.112
Age-CV	-0.291	0.016

CV=Conduction velocity. r=Pearson correlation coefficient



This graph shows negative correlation (r = -0.291) between age and Conduction velocity.

Fig 3: Correlation graph

Discussion

Normal reference data of nerve conduction studies are useful for detection of nerve functioning. Test data showing values outside the reference range suggests some abnormal nerve functions. Various studies suggested that ethnicity and demographic factors also influence the nerve conduction [12-13]. This study is by far the first study in Odisha population to find the normative values of sural conduction parameters in healthy subjects. In traditional clinical practice the clinicians do not consider age and sex factor of conduction parameters which leads to erroneous diagnosis. Therefore this study provides healthy data of sural conduction parameters which can be helpful in clinical diagnosis.

This study suggested that the latency is longer in older age group than younger and conduction velocity is lower in older age group than younger. Latency is longer in female than male and conduction velocity in female is less than the male. Also there was negative correlation between age and conduction velocity which suggests that conduction velocity decreases with increasing age. Similar type of result was recorded by study of Sreenivasan *et al.* which suggested that latency is longer in older age group subjects [2]. Similar type of result was also reported by another study Lambert *et al.* [14] Various studies suggested that with increasing age the conduction velocity and amplitude decreases [15-17]. Gender influences the variation a little while the variation in different gender is due to differences in height. Some studies have shown that sural conduction velocity decreases with age and height [18, 19] while others have not found an association [20, 21]. The reason for this decrease was attributed by various studies to decrease in number of nerve fibers, reduction in fiber diameter, and changes in the fiber membrane.[15-17] Decrease in the diameter of the fiber distally may explain the decrease in nerve conduction function as proposed in earlier studies.[22]

Conclusion

This study concludes that age and gender are the important determinants for sural nerve conduction. Therefore clinicians should not ignore these factors for the point of diagnosis and prognosis of disease.

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