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Effect of age on the nerve conduction velocity and H-Reflex in normal subjects and formulating age correction formula and testing the reliability of existing formula

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ABSTRACT

Many studies have been done on effect of age on H-reflex and motor nerve conduction velocity but all have controversial results. In this study effect of age on H-reflex and MNCV of Tibial and CPN was studied on 50 healthy normal subjects which were divided five age groups which are 10-20, 20-30, 30-40, 40-50, 50-60, with 5 males and 5 females in each group. The F-value for any of the variable was not significant against table value 2.57 and the correlation values show that in Gp1 there is significant correlation between tibial and CPN LD, in Gp2 H-latency and tibial LD, in Gp3 between H-latency and tibial LD, CPN MNCV and tibial NCV, H-latency and CPN LD, CPN MNCV and tibial MNCV, in Gp4 between H-latency and CPN LD and in Gp5 significant correlation not between any of the values. It was concluded that there is no significant effect of age on H-reflex and MNCV of tibial nerve and CPN and there is no significant difference in the values of H-reflex and CPN MNCV between both the sexes except tibial MNCV. The age correction formula for H-latency could not be created because of little variations in the mean values.

Key words Age, H-reflex, tibial motor nerve conduction velocity (MNCV), common peroneal nerve (CPN) MNCV, latency difference (LD) sex.

INTRODUCTION

The process of myelination is age dependent and begins *in utero,* with nerve conduction velocity approximately one half of normal adult values in a full term infant. Premature infants have very slow nerve conduction velocity (Cerra and Johnson,1962). As the myelination progresses, the nerve conduction velocity attains the adult value by 3-5years of age. The conduction velocity begins to decline after 30-40 years. Conduction velocities decrease slightly with age in adults, most likely as a consequence of the normal loss of motor and sensory neurons that occur with ageing.

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Nerve conduction studies (NCS) are performed to diagnosis disorders of the peripheral nervous system and to detect neurologic response of demyelination and axon loss. Nerve conduction velocity (NCV) measurements are a type of NCS, and are primarily of three types: motor, sensory and mixed

MISHRA AND KALITA; SULLIVAN AND SCHMITZ

Awang Saufi M. et al demonstrated a significant decrease in nerve conduction velocity with increasing age. Y.L. Lo et al also showed a decreasing trend of sensory amplitudes with increasing age. Also Marco A. S. F. found an increase in H-latency with increasing age. But Sadeghi Shahram et al did not found a significant correlation between age and latency of H- reflex.

These statements give lot of confusion regarding effect of age on electric properties of nerves. In order to improve the diagnostic yield of electrophysiological studies in individual patients, I have studied the effect of age on easily elicitable late respone H-reflex and tibial and CPN MNCV. So that, obtained database can be used in the formulation of age correction formula.

H-REFLEX :HOFFMAN

described the H- reflex in 1918 and hence it is named as H-reflex. The H- reflex is a monosynaptic reflex elicited by sub maximal stimulation of the tibial nerve and recorded from the calf muscle.

MOTOR NERVE CONDUCTION VELOCITY (MNCV)

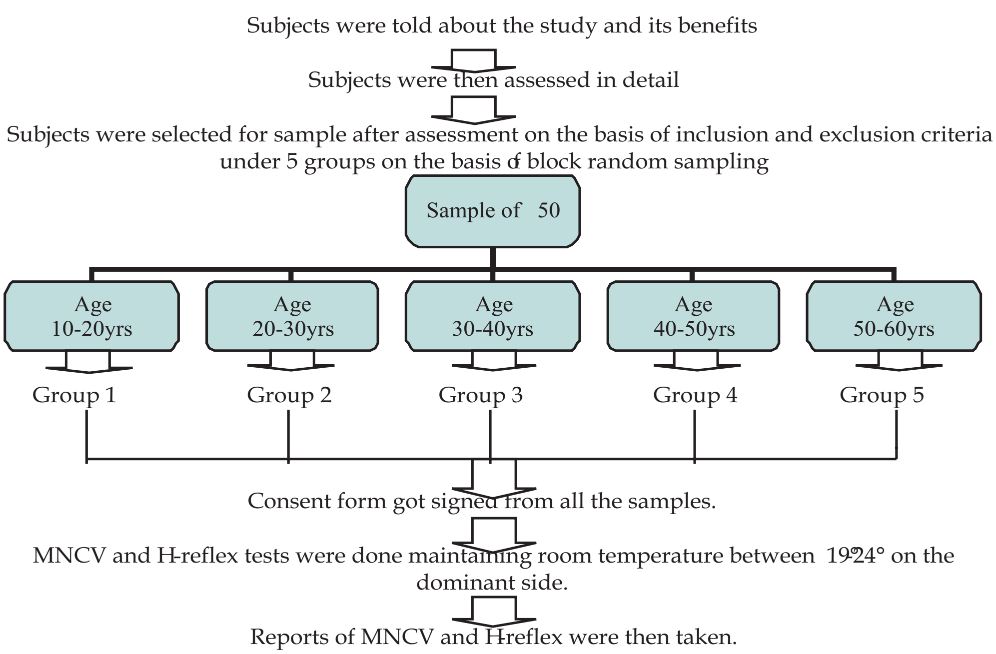
It is defined as the speed with which motor axons of a mixed nerve conducts an impulse, which was recorded (evoked potential) from a distal muscle innervated by the nerve.

METHODS

Study was performed on 50 male and female subjects were taken from the city Patiala which were divided into five age groups age group of 10-20, 20-30, 30-40, 40-50, 50-60. This was an comparison and correlation study, which was performed in the Punjabi university, Patiala in Neurophysiology lab of Department of Physiotherapy. Study was performed in accordance with ethical consideration of the institute and their consent was taken prior to the study.

TESTING EQUIPMENT AND PROCEDURE

Nerve conduction studies were performed on (Neuroperfect) EMG/NCV/EP system, EMG 2000; Medicaid system ISO (9001:2000) certified. Before beginning with the procedure, the subjects who were selected on the basis of convenient block sampling by applying inclusion criteria were



Parameters studied: H-latency, H/M for H -reflex, CPN latency difference and CPN MNCV, tibial latency difference and tibial MNCV for motor nerve conduction velocity.

explained the entire procedure in detail. They were then assessed according to the assessment chart.

PROCEDURE

The subject was made to lie prone comfortably on a plinth. They were given a 5 minute time for relaxation and her all physical activities was stopped prior to test. Any Metallic ornaments on the limb were removed. The right leg was exposed from foot to popletial fossa. The resistance of the skin of forearm was reduced using cotton dipped in alcohol. The room temperature was noted. The electrodes were placed first on the right leg to record H-reflex.

PICK UP ELECTRODE

on point of bisection on the line connecting the popliteal crease and the proximal flare of the medial malleolus.

REFERENCE ELECTRODE

over Achilles tendon**. Ground electrode** between site of stimulation and pickup.

STIMULATING ELECTRODE

the cathode is proximal and is placed over the tibial nerve in the popliteal fossa at the level of the popliteal crease. The sub maximal stimulation was given to the tibial nerve distally at the level of the popliteal crease and a motor response was recorded from the medial position of soleus muscle. A square wave pulse of 1ms duration is used for preferential stimulation of large sensory fibers. The stimuli are adjusted so as to evoke maximum H-response amplitude. By increasing the stimulus strength to supramaximal maximum M response can be reordered and 3 M responses are measured for analysis. H/M ratio which is measured from peak to peak amplitude. The latency of H reflex is measured from the stimulus artifact to the first deflection from baseline.

In prone position positions of active and reference electrodes are changed for recording of tibial motor nerve conduction velocity at distal points.

PICK UP ELECTRODE

over abductor hallucis slightly below and anterior to navicular tuberosity. Reference electrode: 2cm distal to active electrode. Ground electrode: between stimulation and pickup sites.

STIMULATING ELECTRODE

Distal stimulation – behind and proximal to the medial malleolus Proximal – in the popliteal fossa along the flexor crease of the knee slightly lateral to the midline of the popliteal fossa.

Latency as the first deflection from the baseline when stimulation was given at distal point was calculated as L1 and at proximal point was calculated as L2 and amplitude of compound muscle action potentials as peak of wave was measured. Then the motor nerve conduction velocity was calculated by multiplying the distance between distal and proximal stimulation point and latency difference between L1 and L2. MNCV values were calculated by using the formula.

Then the subject was made to lie supine comfortably on a plinth with leg and foot supported. Right leg was exposed upto knee level. Then motor nerve conduction velocity of common peroneal nerve is to be recorded for distal latency. Pick up electrode: over extensor digitorum brevis. Reference electrode: 2cm distal to active electrode. Ground electrode: between stimulation and

$$\text{Conduction Velocity (m/sec)} = \frac{\text{Distance}}{\text{Proximal latency - Distal Lat}}$$

pickup sites. Stimulating electrode Distal stimulation – ankle, 2cm distal to the fibular neck. Proximal stimulation – at the neck of fibula and 5-8cm above the fibular neck.

Latency as the first deflection from the baseline when stimulation was given at distal point was calculated as L1 and at proximal point was calculated as L2 and amplitude of compound muscle action potentials as peak of wave was measured. Then the motor nerve conduction velocity was calculated by multiplying the distance between distal and proximal stimulation point and latency difference between L1 and L2. MNCV values were calculated by using the formula.

$$\text{Conduction Velocity (m/sec)} = \frac{\text{Distance}}{\text{Proximal latency - Distal Latency}}$$

RESULTS AND DISCUSSION

Mean and standard deviation for H-latency and H/M is 28.9340±0.6651 and 0.466±3.847 respectively, for tibial MNCV and LD 44.902±1.0141 and 8.494±0.23 respectively, for CPN MNCV and CPN LD 46.644±2.3637 respectively. Using ANOVA it was found that there is no significant difference between H-latency, H/M, Tibial LD, Tibial MNCV, CPN LD, CPN MNCV. This proves the null hypothesis of this study, that there are no significant changes in MNCV and H-reflex with increasing age of the age group of 10-60.

Karl Pearson Correlation values show that in Gp1 there is significant correlation between tibial and CPN latency difference, in Gp2 H-latency and tibial latency difference, in Gp3 between H-latency and tibial latency difference, CPN MNCV and tibial NCV, H-latency and CPN latency difference, CPN MNCV and tibial MNCV, in Gp4 between H-latency and CPN latency difference and in Gp5 significant correlation not between any of the values.

Comparison between both the sexes was also done in the study using t test which shows that significant difference between both sexes was found in males and females in tibial MNCV but insignificant difference was found in H-latency, H/M, CPN MNCV, CPN LD, tibial LD. Age correction formula could not be formulated because of very less variation in the values.

Table 1: Mean and standard deviation

	Mean	N	Std. Deviation	Std. Error Mean
Leg length	89.3380	50	5.2897	.7481
BMI	22.9602	50	1.8534	.2621

Table 2: Mean and Standard deviation

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1					
	H-latency	28.9340	5	.6651	.2974
	H/M	.4660	5	3.847	1.720
Pair 2	CPN Lat diff	6.9960	5	.1006	4.501
	CPN MNCV	46.6440	5	2.3637	1.0571
Pair 3	Tibial lat diff	8.4940	5	.2300	.1028
	Tibial MNCV	44.9020	5	1.0141	.4535

The table 1 describes the Mean and Standard deviations of BMI and leg length of all age groups.. mean and Standard deviation of leg length is 89.3380±5.2997, BMI is 22.9602±1.8534.

The table 2 describes the Mean and Standard deviations of all the values of H-reflex and MNCV recorded. Mean and Standard deviation of H-latency is 28.9340±0.6651, H/M is .4660±3.847, CPN Latency difference is 6.9960±0.1006, CPN NCV is 46.6440±2.3637, Tibial latency difference is 8.4940±0.23, Tibial NCV is 44.902±1.0141.

The table 3 describes the difference between the H-latency of the five age groups. There is a significant increase in H-latency noted between 1st (27.97±1.22) and 5th (29.4±0.99) group. The F-value is 1.27 which is less then table value (2.57).

The table 4 describes the difference between H/M of the five age groups. There is significant difference between 1st (0.47±0.23) and 3rd (0.52±0.51) group but not much significant between 1st (0.47±0.23) and 5th (0.48±0.22) group. The F-value is 0.133 which is less then the table value(2.57) The table 5 describes the difference between latency difference of Common Peroneal nerve of the five age groups. The F-value is 0.126 which is less then the table value(2.57).

The table 6 describes the difference between motor nerve conduction velocity of Common Peroneal nerve of the five age groups. The F-value is 1.166 which is less then the table value(2.57).

The table 7 describes the difference between latency difference of Tibial nerve of the five age groups. The F-value is 0.317 which is less then the table value(2.57).

The table 8 describes the difference between motor nerve conduction velocity of Tibial nerve of the five age groups. The F-value is 0.355 which is less then the table value(2.57).

Table 3: ANOVA - H-latency

Groups	*Count*	*Sum*	*Average*	*Variance*
Group 1	10	279.74	27.974	1.496204
Group 2	10	285.01	28.501	6.706121
Group 3	10	294.11	29.411	4.872388
Group 4	10	293.99	29.399	3.349454
Group 5	10	294	29.4	0.9864

ANOVA

Source of Variation	*SS*	*Df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	17.69954	4	4.424885	1.270747	0.295526	2.578737
Within Groups	156.6951	45	3.482114			
Total	174.3947	49				

Table 4: ANOVA - H/M

Groups	*Count*	*Sum*	*Average*	*Variance*
Group 1	10	4.73	0.473	0.054201
Group 2	10	4.23	0.423	0.068401
Group 3	10	5.28	0.528	0.261618
Group 4	10	4.44	0.444	0.18376
Group 5	10	4.89	0.489	0.051788

ANOVA

Source of Variation	*SS*	*Df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	0.066092	4	0.016523	0.1333	0.969316	2.578737
Within Groups	5.57791	45	0.123954			
Total	5.644002	49				

This was an comparison and co-relational study done to see the effect of age on H-reflex and MNCV. This study was designed to study the changes in motor nerve conduction velocity of tibial and common peroneal nerve, H-reflex, H/M in males and females with increasing age. By reviewing literatures it was found that there is decrease in excitability in spinal pathways with

Table 5: ANOVA - CPN latency difference

Groups	Count	Sum	Average	Variance
Group 1	10	69.49	6.949	0.218232
Group 2	10	70.39	7.039	0.56201
Group 3	10	71.09	7.109	2.181632
Group 4	10	68.5	6.85	0.703089
Group 5	10	70.64	7.064	0.528316

ANOVA

Source of Variation	SS	Df	MS	F	P-value	F crit
Between Groups	0.425748	4	0.106437	0.126914	0.971935	2.578737
Within Groups	37.73951	45	0.838656			
Total	38.16526	49				

Table 6: ANOVA – CPN MNCV

Groups	Count	Sum	Average	Variance
Group 1	10	470.75	47.075	12.34883
Group 2	10	473.72	47.372	9.499818
Group 3	10	488.05	48.805	28.76965
Group 4	10	473.91	47.391	21.8719
Group 5	10	425.94	42.594	166.9851

ANOVA

Source of Variation	SS	Df	MS	F	P-value	F crit
Between Groups	223.4612	4	55.86529	1.166411	0.338293	2.578737
Within Groups	2155.277	45	47.89505			
Total	2378.739	49				

Table 7: ANOVA – Tibial latency difference

Groups	Count	Sum	Average	Variance
Group 1	10	82.87	8.287	1.092734
Group 2	10	84.86	8.486	2.583493
Group 3	10	86.12	8.612	2.272396
Group 4	10	88.21	8.821	0.285543
Group 5	10	82.87	8.287	1.887312

ANOVA

Source of Variation	SS	Df	MS	F	P-value	F crit
Between Groups	2.065092	4	0.516273	0.317844	0.86455	2.578737
Within Groups	73.09331	45	1.624296			
Total	75.1584	49				

Table – 8 ANOVA – Tibial MNCV

Groups	Count	Sum	Average	Variance
Group 1	10	451.11	45.111	23.59254
Group 2	10	455.39	45.539	31.48112
Group 3	10	447.8	44.78	24.33942
Group 4	10	432.41	43.241	28.29594
Group 5	10	458.59	45.859	37.79274

ANOVA

Source of Variation	SS	Df	MS	F	P-value	F crit
Between Groups	41.39024	4	10.34756	0.355582	0.838788	2.578737
Within Groups	1309.516	45	29.10035			
Total	1350.906	49				

Fig 1: Graph of Mean, Standard deviation and Standard error of Leg Length and BMI

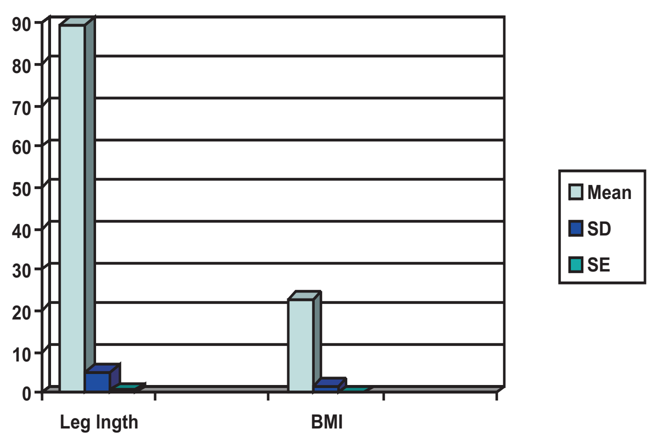


Fig 2: Graph of Mean, Standard deviation and Standard error of H- latency and H/M

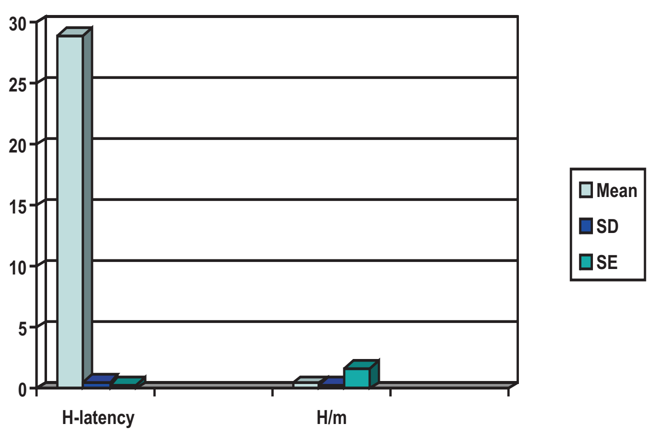


Fig. 3: Graph of Mean, Standard deviation and Standard error of CPN latency difference and CPN MNCV.

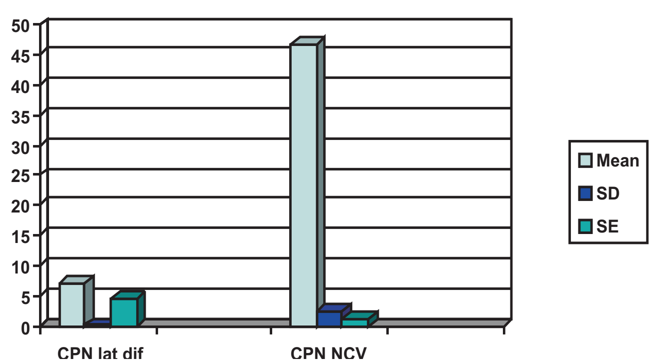
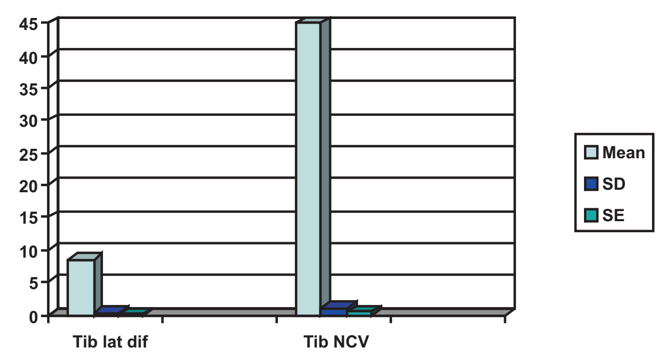


Fig. 4: Graph of Mean, Standard deviation and Standard error of Tibial Latency. Difference and Tibial MNCV.



increasing age, increase in latency of H-reflex and decrease in nerve conduction velocity with increasing age.

According to the null hypothesis of this study the age does not have impact either over MNCV or H-reflex, and this study will not formulate age correction formula for either MNCV or H-reflex and the existing formula of H-reflex is not reliable which says :

H-latency = 0.46 {leg length(cm)} + 9.14 + 0.1 {age(years)}[43]

Earles D et al indicated significant increase in presynaptic inhibition with increasing age and similarly Solange G. Garibaldi and Anarmali nucci found significant relationship between age and sensory nerve conduction velocity of ulnar nerve but Shahram Sadeghi et al in their study said that there is no correlation between latency of H-reflex and age and Maro Arco Aurelio Smith Filgueria said that there is no age influence in H reflex parameters for subjects in the range of 20 to 40 years of age.

In this study Using ANOVA it was found that The F-value for H-latency is 1.27, for H/M is 0.133, for CPN MNCV is 1.16, for CPN LD is 0.126, for tibial MNCV is 0.355 and tibial LD 0.317 against table value 2.57 and thus there is no significant difference between H-latency, H/M, Tibial LD, Tibial MNCV, CPN LD, CPN MNCV. This proves the null hypothesis of this study, that there are no significant changes in MNCV and H-reflex with increasing age of the age group of 10-60.

But the results of my study do not demonstrates the significant effect of age on H-reflex and MNCV as demonstrated by other researches like Nam Sunwoo who in his study on 639 Korean adults over 20years of age demonstrated that physiological factors like age, sex, and height effect nerve conduction velocity independently.

In contrast, the review of literature that supports my study are by Marco aurelio smith filgueria who said that there is no age influence in H reflex parameters for subjects in the range of 20 to 40 years of age, even Mohamed Sufi Awang et al did not find any significant effect of age on nerve conduction velocities except for median nerve uptill 60years of age. Taylor PK said that there is a non-linear effects of age on nerve conduction, out of his 25 sets of data 3 sets did not show any dependence on age of conducion velocity, amplitude and duration.

These partially contradicting results may be attributable to less age range, the evidences are there which strongly suggests that as age increases beyond 60yr, human muscle undergoes continuous denervation and reinnervation, due to an accelerating reduction of functioning motor units (Jan Lexell,1997). The age range upto 65yrs is considered young adult range based on the classification system defined by Seccombe and Ishii-Kuntz. It was also observed that Spinal cord CVs showed little change until approximately age 60, and declined sharply thereafter (Dorfman LJ, Bosley TM). One another study said that there is no age influence in H reflex parameters for subjects in the range of 20 to 40 years of age Marco aurelio smith filgueria Another factor attributable to these results is the active lifestyle of the subjects taken under this study, the subjects were all healthy, normal, independent, all were capable walkers, able to walk continuously Gordon R. Chalmers and Kathleen M. Knutzen they all were working under different occupations and thus not much significant changes were found in nerve conduction velocity and H-reflex parameters, insignificant changes show that there is no significant demyelination in the nerves leading to normal conduction in the nerves as young people.

Another finding of this study is that there is difference in male and female in findings of tibial nerve MNCV but insignificant in other parameters which is in general agreement with Henry C. Tong et al who said that there is no significant change in nerve conduction parameters on the basis of gender.

In the end, we conclude that there is no effect of age on motor nerve conduction velocity and H-reflex upto 60yrs of age and also the sex plays a minor role in the findings of H-reflex and motor nerve conduction velocity as its effect was found only on the motor nerve conduction velocity of the tibial nerve and the age correction formula could not be formulated because of very less variation in the values and the existing formula of the H-latency is proved to be unreliable.

CONCLUSION

From the ANOVA insignificant changes in all parameters was found with increasing age, value of F for H-latency 1.270747, for H/M 0.1333, for CPN latency difference 0.12914, for CPN NCV 1.166, for tibial latency difference 0.317, for tibial NCV 0.355. and correlation study it was suggested that the alternate dose not hold valid and null hypothesis can be drawn from the conclusions and values of t-test for difference in sex for H-latency -4.169, for H/M -2.39, for CPN latency difference -4.392, for CPN NCV 0.317, for tibial latency difference -4.059 which are all insignificant but for tibial NCV is 1.6867 which is more then the table value (1.677) and thus it shows a significant difference in males and females in tibial NCV–

From this study, we conclude that

1. There are no significant changes in H-reflex with increasing age upto 60yrs.
2. There are no significant changes in MNCV with increasing age upto 60yrs.
3. There is no significant sex role in MNCV and H-reflex.
4. The existing formula of H-latency is not reliable.

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