International Journal of Research in Medical Sciences
Subedi P et al. Int J Res Med Sci. 2018 May;6(5):1628-1631
www.msjonline.org
pISSN 2320-6071 | eISSN 2320-6012
DOI: http://dx.doi.org/10.18203/2320-6012.ijrms20181749

Original Research Article

The F waves study in young healthy individuals

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Received: 01 February 2018
Accepted: 06 March 2017

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ABSTRACT

Background: The F wave is a CMAP (compound muscle action potential) evoked by a supramaximal stimulation of a motor nerve. F waves are particularly useful for the diagnoses of polyneuropathies at an early stage and proximal nerve lesions.
Methods: Healthy males (n=64) and females (n=26) medical students of BPKIHS with age 20 to 24 years were enrolled. Anthropometric parameters; F wave latencies, persistence and chronodispersion of bilateral median, ulnar and tibial nerves were recorded in Neurophysiology Lab II of BPKIHS. Descriptive analysis was done.
Results: Mean age, height and weight of the subjects were 21.64±1.19 years, 165.61±5.4cms and 64.07±5.5kg. Mean minimum F wave latencies (ms) of right median, ulnar and tibial nerves were 24.09±1.95, 24.02±1.76, 44.34±3.02 while on the left side were 23.92±1.96, 24.11±1.92, 44.07±2.83 respectively. F persistence was above 80%. F chronodispersion (ms) for right and left median, ulnar and tibial nerves were 2.77±0.70, 2.79±0.65, 2.71±0.67, 2.80±0.56, 3.48±0.73 and 3.45±0.64 respectively.
Conclusions: Maximum and minimum F wave latencies, F chronodispersion and F persistence were derived for both sexes in an age group of 20-24 years.

Keywords: F chronodispersion, F persistence, F wave

INTRODUCTION

The name F wave was derived from the initial recordings which were in the small muscles of the foot. The F wave is a compound muscle action potential (CMAP) evoked by supramaximal stimulation of a motor nerve. F wave involves antidromic excitation of all stimulated motor axons travelling to the spinal cord with reactivation of a small proportion of the anterior horn cell (AHC) axon hillocks and orthodromic action potentials (APs) of one or more motor axons travelling to the muscle. The main nerves tested are the median, ulnar, peroneal and tibial nerves.[1] F waves are useful in the assessment of proximal conduction slowing.[1] F wave studies are most sensitive in detecting acquired demyelinating polyneuropathies, where they may be quite prolonged. In acute inflammatory demyelinating polyneuropathy (AIDP), this may be the only conduction abnormality. In chronic inflammatory demyelinating polyneuropathy (CIDP), F waves may be absent.[2] Similarly, an increase in F wave amplitude is a good reflection of spasticity.[1] F waves have a very high diagnostic value in clinical neurophysiology. Adequate analysis of F waves requires recording a series of F waves. Parameters commonly evaluated include latencies, the difference between minimal and maximal latencies, durations, persistence and amplitude.[3] Thus, we aim to study the different parameters of F waves in normal healthy individuals and to establish the normative data for our laboratory setups.

METHODS

Healthy individuals, male (n=64, mean age of 21.5±1.24 years) and female medical students (n=24, mean age of 22.00±0.98 years) self declared, not on any medication,

not a known case of any disorder was included in the study. Ethical approval was obtained from the Institutional Review Committee. Anthropometric variables and F wave recording of bilateral median, ulnar and tibial nerves using a standard technique with a Nihon Kohden machine (NM-420s, H636, Japan) were done. F wave maximum and minimum latencies, F persistence and F chronodispersion were recorded. The data collected were entered into Microsoft Excel 2007 and analysed using SPSS 11.5 version. Descriptive analysis was done.

RESULTS

Mean age, weight and height for males and females were 21.50±1.24, 22.00±0.98, 65.52±5.20, 60.50±4.70, 167.50±4.92 and 160.90±3.45 respectively as shown in Table 1.

Table 1: Anthropometric variables.

Variables	Males (n=64) Mean±SD	Females (n=26) Mean±SD	P value
Age (years)	21.5±1.24	22.00±0.98	0.04*
Weight (kg)	65.52±5.20	60.50±4.70	<0.001*
Height (cms)	167.50±4.92	160.96±3.45	<0.001*
BMI (kg/m^2)	23.33±1.43	23.33±1.57	0.99

#cm- centimeter, kg- kilogram, BMI- body mass index, p value significant (< or = 0.05)

Table 2: F wave latencies.

Variables (ms)	Males (n=64) Mean±SD	Females (n=26) Mean±SD	P value
RMFMax	27.32±1.80	25.69±1.60	<0.001*
RMFMin	24.70±1.74	22.61±1.63	<0.001*
LMFMax	27.14±2.82	25.72±1.45	<0.001*
LMFMin	24.37±1.87	22.81±1.74	<0.001*
RUFMax	27.21±1.56	25.55±1.32	<0.001*
RUFMin	24.64±1.41	22.48±1.60	<0.001*
LUFMax	27.41±1.71	25.65±1.33	<0.001*
LUFMin	24.64±1.82	22.74±1.43	<0.001*
RTFMax	48.76±3.07	45.66±2.07	<0.001*
RTFMin	45.21±2.88	42.21±2.20	<0.001*
LTFMax	48.36±2.70	45.53±1.55	<0.001*
LTFMin	44.83±2.83	42.18±1.80	<0.001*

#RMFMax-right median maximum F wave latency, RMFMin-right median minimum F wave latency, LMFMax-left median maximum F wave latency, LMFMin-left median minimum F wave latency, RUFMax-right ulnar maximum F wave latency, RUFMin-right ulnar minimum F wave latency, LUFMax-left ulnar maximum F wave latency, LUFMin-left ulnar minimum F wave latency, RTFMax-right tibial maximum F wave latency, RTFMin-right tibial minimum F wave latency, LTFMax-left tibial maximum F wave latency, LTFMin-left tibial minimum F wave latency

Anthropometric variables were statistically significant males and females as shown in Table 2. F waves persistence for both groups were comparable as shown in Table 3. F wave chronodispersion for right median and right ulnar nerves were different in both groups as shown in Table 4 while F chronodispersion for rest of the nerves were comparable between the groups.

Table 3: F wave persistence.

Variables	Males (n=64) Mean±SD	Females (n=26) Mean±SD	P value
RMFPS	7.80±0.40	7.77±0.43	0.78
LMFPS	7.84±0.36	7.92±0.27	0.26
RUFPS	7.84±0.40	7.77±0.43	0.78
LUFPS	7.91±0.29	7.96±0.19	0.30
RTFPS	7.98±0.12	8.00±0.00	0.32
LTFPS	7.97±0.17	8.00±0.00	0.15

#RMFPS-right median F persistence, LMFPS-left median F persistence, RUFPS- right ulnar F persistence, LUFPS-left ulnar F persistence, RTFPS-right tibial F persistence, LTFPS-left tibial F persistence

Table 4: F wave chronodispersion.

Variables (ms)	Males (n=64) Mean±SD	Females (n=26) Mean±SD	P value
RMFCD	2.61±0.70	3.18±0.48	<0.001
LMFCD	2.75±0.66	2.90±0.60	0.33
RUFCD	2.57±0.71	3.07±0.37	<0.001
LUFCD	2.76±0.54	2.91±0.61	0.29
RTFCD	3.50±0.80	3.45±0.53	0.75
LTFCD	3.50±0.65	3.32±0.63	0.22

#RMFCD-right median F chronodispersion, LMFCD-left median F chronodispersion, RUFCD-right ulnar F chronodispersion, LUFCD-left ulnar F chronodispersion, RTFCD-right tibial F chronodispersion, LTFCD-left tibial F chronodispersion

DISCUSSION

The F wave is so named because it was originally studied in the small muscles of the foot. It is one of the several responses that may follow the direct motor (M) response evoked by electrical stimulation of mixed or motor nerves. The most commonly observed and diagnostically useful of these responses, however, is the F wave.[3]

F wave studies are useful in the assessment of proximal conduction slowing.[1] F wave studies are most sensitive in detecting acquired demyelinating polyneuropathies, where they may be quite prolonged. In CIDP, F waves may be absent.[2] Since, F waves have a very high diagnostic value in neurophysiology; the objective of our study was to determine different F wave parameters (minimum latency, persistence and chronodispersion) of peripheral nerves in healthy persons and to establish a normative data.

Mosen SS et al, did a F wave study in healthy volunteers of 18 to 55 years. F minimum latency for median, ulnar

and tibial nerves was 25.18±3.59, 25.56±2.97 and 45.42±9.00 respectively. F persistence for median, ulnar and tibial nerves were 88.15±10.86, 94.23±7.57 and 93.21±7.92 respectively. F chronodispersion for median, ulnar and tibial nerves were 6.18±4.94, 5.51±3.73 and 5.21±2.43 respectively.[4] These values for F minimum latencies and F persistence were nearly similar to our study however, F chronodispersion values were higher as compared to our findings.

Parmar LD et al, did a study on different parameters of F waves of bilateral median, ulnar of upper limbs and posterior tibial and deep common peroneal nerves on 59 healthy participants. F minimum latency for upper limbs and lower limbs were 31-37ms and 60ms respectively. More specifically, mean F minimum latency for ulnar and median nerves were 27.93±2.68ms and 25.03±2.31 respectively. Similarly, F mean minimum latency for lower limbs was 50.66±4.72ms.[5] These findings are little higher than our values of F minimum latencies for upper and lower limbs.

Taksande et al, did a study on 175 healthy volunteers (131 males and 44 females) with a mean age 33.32±9.94 years. F minimum latencies for right and left median, ulnar and tibial nerves were 26.26±2.26, 25.91±2.00, 27.01±2.34, 26.53±2.00, 46.53±4.04 and 46.47±4.00 respectively in males. Meanwhile, F minimum latencies for right and left median, ulnar and tibial nerves were 24.09±2.09, 23.68±1.12, 25.20±2.72, 24.1±1.65, 43.44±2.53 and 43.79±3.01 respectively in females. Values for males and females were statistically significant with the $p<0.05$.[6] These values of F minimal latencies are in accordance with our findings.

Likewise, in this study F minimum latencies for right and left median and ulnar nerves of upper limbs are 26.85±1.89, 23.92±1.96, 24.02±1.76 and 24.11±1.92 respectively. Minimum F latency of right and left tibial nerves of lower limbs are 44.34±3.02 and 44.07±2.83 respectively. And, these values are statistically different between the sexes ($p<0.001$). The effect of sex on nerve conduction parameters can be explained on the basis of gender wise difference in anatomical and physiological factors.[7] This gender difference in nerve conduction parameters could be due to the difference in height.[8]

Ghosh S et al, studied different F wave parameters of ulnar and median nerves in seventeen healthy male volunteers aged 19-46 years. F minimum latency, F maximum latency, mean F latency, chronodispersion and persistence of median and ulnar nerves were 24.8±1.7ms, 29.8±2.8ms, 26.8±1.4ms, 5±2.8ms, 40-100% and 24.5±1.7ms, 28.2±1.8ms, 26.2±1.7ms, 3.6±1.4ms, 40-100% respectively.[9] The study concluded that there was a significant difference between median and ulnar nerve F wave maximal latency, mean latency and chronodispersion.

However, our study showed chronodispersion for right and left median and ulnar nerves to be 2.77±0.70ms, 2.79±0.65ms, 2.71±0.67ms and 2.80±0.56ms respectively. These values are less as compared to Ghosh et al study. Also, F persistence for both ulnar and median nerves were >80%.

Nobrega JA et al, did a study on different parameters of ulnar and tibial nerves from 100 healthy volunteers.[10] F persistence for ulnar and tibial nerves were 83±19% and 97±5%. And, this finding is in accordance with our study. F minimum and maximum latencies (ms) for ulnar and tibial nerves were 26.5±2.1, 30.4±2.3, 47.0±4.1 and 52.5±4.4 respectively. Similarly, chronodispersion (ms) were 3.9±0.9 and 5.5±1.4 respectively. F latencies and chronodispersion values are higher than our findings.

CONCLUSION

Mean F wave latencies (maximum and minimum F wave), F persistence and F chronodispersion were derived for bilateral ulnar, median and tibial nerves for males and females with an age group of 20-24 years.

ACKNOWLEDGEMENTS

Authors would like to thank all the subjects who participated in the study.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Review Committee (IRC), BPKIHS

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Cite this article as: Subedi P, Limbu N, Thakur D, Khadka R, Gupta S. The F waves study in young healthy individuals. Int J Res Med Sci 2018;6:1628-31.