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Importance of Measuring Manual F-Wave Persistence

Manuel F Dalga Persistansı Ölçümünün Önemi

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Summary

Objective: Many of the F-waves were not marked correctly by automatic computerized processes while doing nerve conduction study. This study was done to investigate if there is any importance to measure the F-wave persistence values manually while doing nerve conduction studies.

Materials and Methods: A total of 60 patients (18 men) aged 19-65 (average 37±11.5) years were included and 78 nerve conduction studies were performed for analysis of ulnar nerve F-wave parameters; the subjects had normal results of the motor and sensory ulnar nerve conduction studies. F-wave persistence was recorded automatically by a computer (automated persistence). We observed that the software did not mark few F-waves correctly, therefore, we counted them manually (manual persistence).

Results: Ulnar nerve F-wave persistence, measured manually and automatedly, showed significant difference when analyzed by Wilcoxon signed-rank test ($Z=3.24$, $p<0.005$), indicating significantly increased persistence, when calculated manually, in comparison with the automated persistence. In 78 nerve conduction studies, the manual persistence was greater than the automated persistence in 25, less than the utomated one in 5 and equal to it in 48 measurements.

Conclusion: Manual persistence is recommended for F-wave persistence measurements whenever needed. This study suggests also that there is a necessity for improvement in the software for the F-wave studies. *Turk J Phys Med Rehab 2010;56:186-9.*

Key Words: Electrophysiological processes, nerve conduction study, F-wave, F-wave persistence

Özet

Amaç: Sinir iletim çalışmalarında F dalgalarının çoğunda bilgisayarın otomatik işaretlemeleri doğru olarak yapılamamaktadır. Bu çalışma, sinir iletim çalışması yapılırken F dalgası persistans değerlerinin manuel olarak ölçülmesinin bir önemi olup olmadığını incelemek için yapılmıştır.

Gereç ve Yöntem: Çalışmaya motor ve duyusal ulnar sinir iletim çalışmaları normal olan 19-65 yaş arası (ortalama yaş: 37±11,5) toplam 60 hasta (18 erkek) dahil edildi. Ulnar sinir F dalga parametrelerinin incelenmesi için 78 sinir iletim çalışması yapıldı. F dalga persistansı bilgisayar tarafından otomatik olarak kaydedildi (otomatik persistans). Yazılımın F dalgalarını doğru olarak göstermediğinin gözlemlenmesi ile persistans manuel olarak tekrar hesaplandı.

Bulgular: Manuel ve otomatik olarak ölçülen ulnar sinir F dalga persistansı Wilcoxon signed-rank testi ile incelendiğinde iki yöntem sonuçları arasında anlamlı farklılık olduğu görüldü ($z=3,24$, $p=0,005$). Manuel olarak ölçüldüğünde, otomatik olana kıyasla, persistans ciddi anlamda artmıştı. Yetmiş sekiz sinir iletim çalışmasının 25'inde manuel persistans otomatik persistanstan daha yüksek, 5'inde daha az, 48'inde ise eşitti.

Sonuç: F dalga persistans ölçümünde manuel persistans tavsiye edilir. Bu çalışma ayrıca F dalga çalışmaları için yazılımın geliştirilmesi gerektiğini de önermektedir. *Türk Fiz Tıp Rehab Derg 2010;56:186-9.*

Anahtar Kelimeler: Elektrofizyolojik işlemler, sinir iletim çalışması, F dalgası persistansı

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Introduction

Combined utilization of multiple F-wave parameters is a useful, diagnostic adjunct in the electrophysiological evaluation (1). F-waves are one of the most frequently used studies in clinical neurophysiology and much of the controversies surrounding the use of F-waves relates to a failure to adequately consider the requirements of F-wave analysis (2). Therefore, correct analysis of F-waves is important. We observed that many of the F-waves were not being marked correctly by automated computerized processes (automated F-waves). Corrections were made manually (manual F-waves), and then the data were analyzed. The aim of this study was to determine if there was any significant difference between automated and manual F-wave measurements and if there is any need to correct the automated F-wave persistence manually.

Materials and Methods

A total of 78 ulnar nerve conduction studies (in 18 subjects done bilaterally) in 60 patients (18 men) aged 19-65 (average 37±11.5) years were taken for analysis of ulnar nerve F-wave parameters. The subjects had normal results of the motor and sensory ulnar nerve conduction studies. Chroni et al. (3) showed that a sample of 40 fulfilled the requirements for all F-wave latency parameters of the peroneal nerve in almost all subjects, a finding that is in good agreement with that of a similar study of the ulnar nerve. Subjects with various symptoms were referred from the Northern region of Saudi Arabia for nerve conduction studies. Data were collected from October 2005 to October 2007.

Each subject underwent motor nerve conduction studies, antidromic sensory nerve conduction studies and F-wave studies for ulnar nerve in one or both sides. Studies were conducted using a Schwarzer Myos Plus EMG machine (Schwarzer GmbH Medical Equipment for Diagnosis, Baermannstr 38, D-81245, Munich) with filter setting at 20 Hz-10,000 Hz, in a warm room, maintaining the skin temperature above 32 degrees Celsius. A gain of 5000 μV per division was used for all M-response latency measurements. For the F-wave, amplifier gain was 200 μV per division and a sweep of 5 ms was used (Figures 1 and 2).

F-wave studies consisted of applying ten supramaximal stimulations to the ulnar nerve with the cathode proximal to the anode at the wrist and recording F-waves from the abductor digiti minimi with disk electrodes placed over the belly (active) and tendon of the muscle (reference) (4-6). Measurements included: (1) Persistence, or the number of responses elicited by ten supramaximal stimuli, (2) Minimum, mean and maximum latencies, and (3) chronodispersion or the latency difference between minimum and maximum responses (7,8). The mean latency was calculated by dividing the sum of all latencies by the number of F-waves recorded in each trial. F-wave latencies and chronodispersion values were automatically generated by the computer. The baseline was clearly discernible during the recording; no special attempts were made to produce facilitation.

F-wave persistence was recorded automatically by the computer (automated persistence) and also manually (manual persistence). As an example, in Figure 1, we can see that the fifth tracing of the F-wave was not marked automatically by the computer, so we calculated the automated F-wave persistence as nine and the manual persistence as ten. In Figure 2, we can observe that though the automated persistence is ten, we could only recognize seven F-waves. So, we calculated the manual persistence value as seven. Automated persistence and manual persistence values were analyzed by Wilcoxon signed-rank test to observe if there is any significant difference between them.

Data were analyzed by SPSS software version 11.5.

Results

Normal results of ulnar nerve motor and sensory conduction study observed in our study are presented in Table 1.

The values of normal ulnar nerve F-wave parameters are given in Table 2. We measured the persistence in mode rather than in mean because of the nature of the data.

Ulnar nerve F-wave persistence, measured manually and automatedly, showed significant difference when analyzed by Wilcoxon signed-rank test ($Z=3.24$, $p<0.005$). This result indicated significantly increased manual persistence compared to the automated persistence (Table 3). In a total of seventy-eight persistence studies, the manual persistence was greater than the automated persistence in 25, less than the automated one in 5 and equal to it in 48.

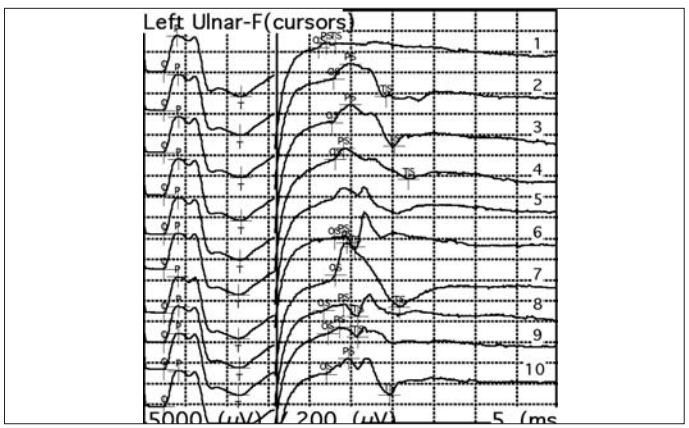

Figure 1. F-wave tracing number five not marked in automated persistence.

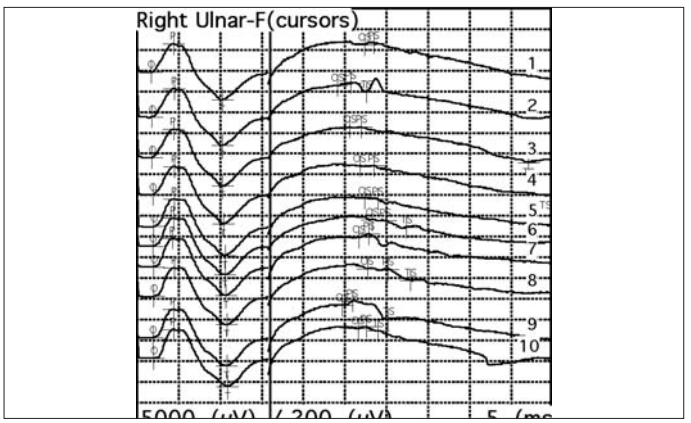

Figure 2. Automated third, fourth and fifth F-wave tracings are not clearly recognizable manually.

Discussion

The normal values of ulnar nerve F-wave parameters observed in this study were similar to those obtained in other studies (5,8,9). The minor differences between this study and similar studies could be due to many factors. The liability of the phenomenon itself (10), correct maintenance of skin temperature, stimulation rate variation (11), and minute differences in methodologies (12) for F-wave conduction studies could be the factors involved.

There was a significant difference between the values of manual and automated F-wave persistence in our study. Manual persistence values were more in comparison to automated persistence in 25 ulnar nerve F-wave studies (32%). Automated F-wave persistence values were more in 5 ulnar nerve F-wave studies (6%). Values of manual and automated persistence were equal in 48 (62%) ulnar nerve F-wave studies. So, in 38% of ulnar nerve F-wave studies, the automated F-wave studies differed from the manual ones. Because of the nature of these data, though the numeric difference of rank m between automated and manual persistence was narrow, statistically there was a significant difference between manual and automated persistence. This observation indicated that we should correct our automated F-wave persistence data manually, because sometimes computer do not mark the distinct F-waves or mark erroneously as F-wave when there is no F-wave visible. In the literature, we found only two related articles. Fisher (13) evaluated the accuracy and reliability of an automated analysis method over the manual method for F-wave latencies. He used NEUROMetrix (Waltham, MA) for automated F-wave measurement and compared it with the manual one done by a clinical neurophysiologist. He found that computerized automated F-wave measurements were reliable with yield rate of hundred percent with a correlation coefficient of 0.996. Kong et al. (14) used an automated NCS system (NC-stat, NeuroMetrix, Inc.) for comparison with traditional electromyography laboratories and found that F-wave latencies have the highest repeatability. In our study, the significant increase in manual persistence when compared to automated persistence indicated an inherent fault in the software to detect some recognizable F-waves and sometimes marking F-wave when there is no wave visible. The cause of this erroneous marking process by computer may be due to problem in the linkage between decision-making process and marking system of the computer (15). It can be suggested that further improvement in the software for our EMG machine is needed to detect F-waves.

From this study, it is concluded that manual correction of automated persistence should be done, when necessary, to get the correct F-wave persistence value. This study was conducted to draw the attention of the clinicians who are facing similar problems with automated F-waves markings. We suggest that manual correction of wrong F-wave automated markings should be performed when necessary and also that there is a need for improvement in the software for F-wave study.

Data from this study should be utilized when similar methods of studies are applied. Software used by various EMG machines of different companies also should be analyzed for any difference between the manual and computerized F-wave parameters.

Table 1. Normal ulnar motor and sensory nerve conduction studies.

	N	Mean	SD
Distal Motor Latency (ms)	78	2.2	0.3
CMAP Amplitude (mV)	78	8.7	2.1
Motor conduction velocity (m/s)	78	71.0	8.7
Distal sensory latency (ms)	78	1.7	0.2
SNAP (μV)	78	47.5	22.2
Sensory conduction velocity (m/s)	78	56.8	5.9

ms: milliseconds, mV: millivolt, μV=microvolt, m/s=meters per second, CMAP: Compound muscle action potential, SNAP: sensory nerve action potential.

Table 2. Normal ulnar nerve F-wave parameters.

	N	Minimum	Maximum	Mean	SD
Minimum F-latency (ms)	78	21.02	31.02	25.30	2.39
Maximum F-latency (ms)	78	23.59	39.38	28.32	2.94
Chronodispersion (ms)	78	0.31	10.55	3.01	1.86
Mean F-latency (ms)	78	22.46	34.79	26.70	2.50
Persistence manual	78	6.00	10.00	*	
Persistence automated	78	6.00	10.00	†	

*Mode=10; †Mode=10

Table 3. Difference between ulnar nerve F-wave manual and automated persistence.

	M rank	Z
Manual persistence	15.52	3.24*
Automated persistence	15.40	

*p<0.005.

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