Caspian Journal of Neurological Sciences
http://cjns.gums.ac.ir

Diagnostic Sensitivity of F-wave Parameters in Unilateral S1 Radiculopathy

Memar-Montazerin Sahar (MD) [1] , *Khorvash Fariborz (MD)* [2] , *Ghasemi Majid (MD)* [3*] , *Mirzaei Samira (MD)* [1] , *Khazaeili Mahdis (MD)* [1] , *Mousavi Seyed-Morteza (BS)* [4]

ARTICLE INFO

Article type:
Original Article

Article history:
Received: 2 December 2015
Accepted: 6 January 2016
Available online: 30 September 2016
CJNS 2016; 2 (6): 20-24

1. Isfahan University of Medical Sciences, Isfahan, Iran
2. Assistant Professor of Neurology, Department of Neurology, Isfahan Neuroscience Research Center, Alzahra Hospital, Isfahan University of Medical Sciences, Isfahan, Iran
3. Associate Professor of Neurology, Department of Neurology, Isfahan Neuroscience Research Center, Alzahra Hospital, Isfahan University of Medical Sciences, Isfahan, Iran
4. BS of life sciences, University of British Columbia ,Vancouver

Corresponding author:
Associate Professor of Neurology, Department of Neurology, Isfahan Neuroscience Research Center, Alzahra Hospital, Isfahan University of Medical Sciences, Isfahan, Iran
Email:ghasemimajid59@yahoo.com

ABSTRACT

Background: F-wave study, part of electrodiagnostic study, has had a controversial sensitivity in the diagnosis of lumbosacral radiculopathy. **Objectives:** We aimed to compare F wave parameters obtained from the tibial nerve of both extremities in patients with unilateral S1 radiculopathy.
Materials and Methods: The study was done from March to September 2015 in the Electrodiagnostic laboratory of an academic hospital affiliated to Isfahan University of Medical Sciences. 19 consecutive patients with clinically and electromyographically approved diagnosis of unilateral S1 radiculopathy entered the study. F-wave parameters (F minimum latency, F maximum latency, F chronodispersion and F persistence) were recorded from tibial nerve of both extremities. Patients with diabetes, bilateral S1 radiculopathy or any other disease known to affect peripheral nerves were excluded from the study.
Results: Of nineteen participants, 11 were men. Their mean±SD of age was 46.6±13.7 years. There were no significant differences between mean of F wave parameters recorded from affected and unaffected sides. Also, it was shown that, there was a positive correlation between these parameters in two extremities.
Conclusion: The current study compared various F-wave parameters and the results did not support employing F-wave study as a sensitive method for detecting unilateral S1 radiculopathy.

Keywords: Radiculopathy; Electrodiagnosis

➢ *Please cite this paper as:*
Memar-Montazerin S, Khorvash F, Ghasemi M, Mirzaei S, Khazaeili M, Mousavi SM . Diagnostic sensitivity of F-wave Parameters in Unilateral S1 Radiculopathy. Caspian J Neurol Sci 2016; 2(6):20-24.

Introduction

Low back pain (LBP) is the major cause of disability and the sixth cause of poor health in the society (1). Various prevalence rates have been reported in different studies ranged from 5% to 65% with a mean value of 18.7% (SD=4.6). The economic burden of chronic LBP is crystal clear (2).

Chronic LBP is defined as LBP that lasts three months either constantly or intermittently. It is a multi-factorial disease and various reasons might cause LBP including Inter-vertebral *Disc Herniation (IDH).* IDH occurred in L_4-L_5 and L_5-S_1 levels by 90-97% cases and affects mostly middle aged men. (3).

MRI and Electrodiagnostic Study (EDX) are the known studies used for detection of radiculopathy. EDX, a neuro-physiological investigation, detects functional abnormalities of nerve root as well as intensity and duration of the disease (4). F wave study, part of EDX, has had a controversial sensitivity in diagnosing radiculopathies in different studies (5-10). For instance, a study showed that comparing F-wave parameters in two limbs can be beneficial in detecting unilateral S_1 radiculopathy and reduce the false negative results of this assessment (11-12). Another study has shown that F waves are sensitive in early stages of diagnosis and mild radiculopathy (13).

According to what has been mentioned, radiculopathy affects most of the productive people of the society and its diagnosis with MRI has poor specificity because degenerative changes and disc herniation are often seen in healthy people, too. Electromyography is more specific although it is painful and invasive (4).

The objective of the present study is to compare different F-wave parameters obtained from the tibial nerve of both extremities in patients with unilateral S_1 radiculopathy. If there is a significant difference, this method can be applied as a sensitive test in detecting radiculopathy and to increase the sensitivity and specificity of other tests or as an alternative to them.

Materials and Methods

This cross-sectional study was done in patients refereeing to Electrodiagnostic laboratory of an educatinal hospital affiliated to Isfahan University of Medical Sciences from March to September 2015. Initially, patients with at least one of the clinical symptoms of S_1 radiculopathy were evaluated by Needle Electromyography. Clinical symptoms used in detecting S_1 radiculopathy were as follows: 1) history of LBP radiating to S_1 segmental distribution 2) S_1 dermatomal sensory loss or numbness 3) ankle reflex loss 4) S_1 segmental weakness. Also, in order to avoid potential confounding factors, some participants were excluded from the study including: patients with bilateral S1 radiculopathy; patients with diabetes or any other diseases that could affect peripheral nerves; people undergoing needle electromyography who had developed neuropathy; and patients with other lumbosacral root compressions, either unilateral or bilateral. Finally, 19 patients participated in the study.

Spontaneous electrical activity, polyphasic motor unit potentials, maximal interference patterns and recruitment were measured during needle electromyography while the temperature was maintained above 32C°. All electrophysiological studies were recorded by Medelec Synergy (Electroneuromyography machine). F-wave parameters of tibial nerve were measured in the affected and unaffected extremities by sending 20 stimuli at a frequency of 0.5 Hz with filter setting of 2-3 Hz. The sensitivity and speed sweep of the machine were set to 1 mV and 100 miliseconds, respectively. The F-wave parameters recorded are as follows: 1) F minimum latency: minimal latency value, 2)

F maximum latency: maximum latency value among 20 consecutive stimuli, 3) F chronodispersion: the difference between minimum and maximum F-wave latency, 4) F persistence: the number of measurable F-waves divided by number of stimuli.

The present study was approved by the ethics committee of Isfahan University of Medical Sciences and all patients gave their consent to participate in the study after being completely informed about the procedure.

The statistical analyses were performed using SPSS 20 employing Paired t-test and Wil-Coxone test. The level of significance was set at $p<0.05$.

Results

Of 19 patients with unilateral S1 radiculopathy, 11 were men (58%). Their age ranged from 25 to 75 (mean 46.4 ± 13.7) years. Distribution of data was examined using Kolmogorov-Smirnov test and it was shown that all data were distributed normally. Table 1 presents the mean values of the studied parameters (F min latency, F persistence, F chronodispersion, F max latency) in the limb with radiculopathy and in the healthy limb.

Table 1: Comparison of F wave parameters in both extremities.

variable	Affected side	Unaffected side	*p-value*
	Mean± SD*	Mean± SD*	
F min latency	46.99±5.63	46.98±4.58	0.998
F max latency	50.96±5.14	50.2±4.71	0.155
F chronodispersion	3.97±1.41	3.21±1.61	0.43
F persistence	98.95±3.15	100±0	0.16
*Standard Deviation			

According to Table 1, the mean values of F-wave parameters were not significantly different in both limbs. In other words, S1 radiculopathy did not have a significant effect on F-wave parameters.

Pearson-correlation coefficient showed a significant positive correlation between both extremities in F max latency (r=0.901 and *p-value* < 0.001). In the other words, the more this parameter was in the affected side, the more it would be in unaffected side. The same was true for F min latency (r=0.694 and *p-value*=0.001) and chronodispersion (r=0.367 and *p-value*=0.01).

Discussion

The present study showed that comparing the F-wave parameters in affected and unaffected limbs was not sensitive enough to detect S1 radiculopathy. In other words, electromyography which is used to diagnose radiculopathy cannot be replaced with F-wave study. However, another research conducted with 20 patients with S1 radiculopathy and 20 controls in Turkey showed that detailed F-wave study, particularly the F duration (F dur) and F chronodispersion (F ch), can be helpful in detecting S1 radiculopathy (13). In another study on 108 patients with lumbosacral mono-radiculopathy, the F min latency was abnormal in only 19% of patients. This study explained that electrophysiological and motor neurographic anomalies occur when nerve fibers are injured severely. Therefore, these studies are not sensitive for radiculopathy diagnosis and their value is preferably to determine the severity of root damage (14). It has also been proved in another study that the sensitivity of F ch decreases in detecting mild radiculopathy (13). It must be noted though that the participants of the present study were diagnosed with mild radiculopathy in electromyography. Moreover, it seems that diagnostic sensitivity of F wave study depends on the involved nerve. As in one study, it was observed that in S_1

radiculopathy the proportion of abnormal F waves were lower and F chronodispersion were significantly abnormal only in L_5 radiculopathy (7). The other study showed that abnormal F chronodispersion in proneal nerve was twice compared with tibial nerve (15).

F-wave study has some limitations. It is unable to indicate incomplete injuries of nerve fibers and in injuries involving single nerve root can be normal. This can be explained by the fact that even in intervertebral disc herniation which compresses nerve root and causes motor conduction abnormality, F min latency may be recorded from F-wave traveling through the other unaffected roots or unaffected part of involved root and remains normal. Thus, F min is recorded as normal although radiculopathy exists (8, 12). Hence, its diagnostic sensitivity in radiculopathy has been reported to be lower than polyneuropathy (15).

This study displayed that F wave parameters (F min, F max, and F ch) have significant positive correlation in both extremities and if a parameter was longer in the affected side, it would be longer in the healthy side too. Thereby, it seems that its prolongation may be because of height of the extremity. It is consistent with Lin's study. Lin *et al.* showed that F wave latencies in patients with cervical radiculopathies were not significant when they were adjusted for height and age (6).

Having a small sample size was the most important limitation of the current study. Furthermore, the variable of F dur was not included in the studied parameters so it is recommended to asses this variable in future investigations. As we compare both extremities of the same person, we did not consider measurement of person's height in this study.

Conclusion

The current study compared various F-wave parameters between two limbs and the results did not support employing F-wave as a sensitive method for detecting unilateral S_1 radiculopathy.

Acknowledgement

We would like to express our sincere appreciation to Mr. Hassanzadeh for his help in performing statistical analysis and the personnel of Electrodiagnostic Center in Kashani Hospital in Isfahan for their cooperation.

Conflict of Interest

The authors have no conflict of interest.

References

1. Hoy D, March L, Brooks P, Blyth F, Woolf A, Bain C, et al. The Global Burden of Low Back Pain: Estimates from the Global Burden of Disease 2010 study. Ann Rheum Dis 2014;73:968-974.
2. Dagenais S, Caro J, Haldeman S. A Systematic Review of Low Back Pain Cost of Illness Studies in the United States and Internationally. Spine J 2008;8(1):8-20.
3. Ali A, Khan SA, Aurangzeb A, Ahmed E, Ali G, Muhammad G, et al. Lumbar Disc Herniation in Patients with Chronic Backache. J Ayub Med Coll Abbottabad 2013;25(3-4):68-70.
4. Nafissi S, Niknam S, Hosseini SS. Electrophysiological Evaluation in Lumbosacral Radiculopathy. Iranian journal of neurology 2012;11(3):83.
5. Aiello I, Patraskakis S, Sau G, Zirattu G, Bissakou M ,Patta G, et al. Diagnostic Value

of Extensor Digitorum Brevis F-wave in L5 Root Compression. Electroencephalogr Clin Neurophysiol 1989;30(2):73-6.

6. Lin CH, Tsai YH, Chang CH, Chen CM, Hsu HC, Wu CY, et al. The Comparison of Multiple F-wave Variable Studies and Magnetic Resonance Imaging Examinations in the Assessment of Cervical Radiculopathy. Am J Phys Med Rehabil 2013;92(9):737-45.
7. Weber F. The Diagnostic Sensitivity of Different F-wave Parameters. J Neurol Neurosur Psychiatry 1998;65(4):535-40.
8. Tsao B. The Electrodiagnosis of Cervical and Lumbosacral Radiculopathy. Neurol Clin 2007;25(2):473-94.
9. Pastore-Olmedo C, Gonzalez O, Geijo-Barrientos E. A Study of F-waves in Patients with Unilateral Lumbosacral Radiculopathy. Eur J Neurol 2009;16(11):1233-9.
10. Berger AR, Sharma K, Lipton RB. Comparison of Motor Conduction Abnormalities in Lumbosacral Radiculopathy and Axonal Polyneuropathy. Muscle Nerve 1999;22(8):1053-7.
11. Fisher MA. The Contemporary Role of F-wave Studies: F-wave Studies: Clinical Utility. Muscle Nerve 1998;21(8):1098-101.
12. Toyokura M, Furukawa T. F-wave Duration in Mild S1 Radiculopathy: Comparison between the Affected and Unaffected Sides. Clin neurophysiol 2002;113(8):1231-5.
13. Gencer M, Uluc K, Cetinkaya Y, Isak B, Tireli H, Us O, et al. Clinical Utility of F-wave Parameters in Unilateral S1 Radiculopathy. Neurosciences (Riyadh) 2011;16:237-41.
14. Mondelli M ,Aretini A, Arrigucci U, Ginanneschi F, Greco G, Sicurelli F. Clinical Findings and Electrodiagnostic Testing in 108 Consecutive Cases of Lumbosacral Radiculopathy Due to Herniated Disc. Neurophysiol Clin 2013;43(4):205-15.
15. Rahbar M, Shakuri SK, Shimis M, Rezamandi H .Comparison of Nerve Conducting Abnormalities in Lumbosacral Radiculopathy and Axonal Polyneuropathy. Medical Journal of Tabriz University of Medical Sciences & Health Services 2007;29(2):53-60 [Text In Persian].