

To Study the Effect of F-wave on Patients of Cervical Radiculities/Radiculopathy

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Abstract

Original Research Article

Cervical radiculopathies are conditions involving a pathological process affecting the spinal nerve root. Commonly, this is a herniated nucleus pulposus that anatomically compresses a nerve root within the spinal canal. This can result in pain (radicular pain), weakness, numbness, or difficulty controlling specific muscles. *Aim* of present study to evaluate diagnostic utility of F-wave Latency on patients of cervical radiculitis/radiculopathy. Thirty five patients with unilateral cervical radiculopathy, confirmed by clinical and magnetic resonance imaging (MRI) evidences were studied. Selected patients were divided in two groups GROUP A- Asymptomatic side in subject clinically diagnosed with radiculitis/radiculopathy is used as control group. GROUP B- Symptomatic side in same subjects clinically diagnosed with radiculitis/radiculopathy used as case group. A high-voltage electrical stimulator was used to elicit nerve response bilaterally at various stimulation sites for the diagnosis of cervical nerve-root radiculopathy. The prolonged F-min latency of median nerve had shown significant variation on symptomatic side as compare to asymptomatic side. These variations in side to side F-wave latency by non-invasive technique brings awareness to clinicians about the radiculopathy and this report may also be useful to clinician for early diagnosis and treatment of patients with this condition, facilitating their recovery and return to regular activity.

Keywords: Cervical radiculopathies (CR), magnetic resonance imaging (MRI), F-minimum Latency (F-min Latency).

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INTRODUCTION

Cervical radiculopathies are conditions involving a pathological process affecting the spinal nerve root. Commonly, this is a herniated nucleus pulposus that anatomically compresses a nerve root within the spinal canal [1]. Clinical symptoms include radicular pain and weakness presenting in a myotomal distribution depending on affected spinal root(s). Common etiologies of radiculopathy include spondylosis, intervertebral disc displacement, or trauma which may result in selective myotomal and dermatomal clinical presentation. Additionally, inflammatory, neoplastic, and infectious processes can also cause radiculopathies (radiculitis), which can result in spinal root compression due to inflammation and swelling. Neuroborreliosis and leptomeningeal spreading of carcinoma or lymphoma (leptomeningeal carcinomatosis and lymphomatosis) may also present with radicular symptoms [2].

Cervical radiculopathies were first described by Semmes and Murphy in 1943, but until the 1950s

many physicians, such as Walshe were reluctant to attribute symptoms to root involvement from intervertebral disk disease. Cervical radiculopathy (mostly involving the C4 to C5 levels) affects 5.5 per 100,000 adults every year, with the highest risk being for adults 35 to 55 year's old[3].

The pain or other symptoms often radiate to the part of the body served by that nerve, if a nerve root impingement involved in the neck can produce pain and weakness in the forearm [4].

Now, a day's due to change in lifestyle as we performing eternal activities on laptops, mobiles and sedentary lifestyle increases the incidence of radiculitis/radiculopathy. Use of MRI and CT-scan for diagnosis of cervical radiculitis/radiculopathy was time consuming and costly, while F-wave studies was cost effective, non-invasive and feasible to be used as early diagnostic tool by side to side variations in various F-wave latency conduction parameters in cervical radiculopathy.

The F-wave is the late muscle response resulting from antidromic activation of motor neurons following peripheral nerve stimulation of their axons. With more proximal stimulation, the latency of F-wave decrease. The F-wave impulse first travels towards the spinal cord before it return to activated distal muscle. The F-wave used to estimate the motor conduction velocity along the proximal segment of axons of peripheral nerves [5].

F-wave Studies were performed to understand the pathophysiology of radiculopathy and conduct the study in a practical manner that optimizes its diagnostic yield. The prolonged F-min latency serves to confirm the presence of radiculopathy, establish the involved nerve root level, determine if axon loss or conduction block is present, grade the severity of the process, estimate the age of the radiculopathy and exclude other peripheral nerve diseases that mimic radiculopathy [6].

MATERIALS & METHODS

A randomized paired-study design was utilized to evaluate F-wave studies elicited with median and ulnar nerves by F-wave stimulation. Thirty five patients in age group of 35-55years with unilateral cervical radiculopathy, confirmed by clinical and magnetic resonance imaging (MRI) evidences were studied. Subjects with Diabetes mellitus, with clinical or electrophysiological evidence of polyneuropathy as well as subjects with symptoms of less than 3 weeks duration, having spinal surgery done within the preceding 15 years and Patient who were equally affected in both the sides were excluded. Institutional Ethics Committee's approval was obtained and study was conducted at fixed room temperature of 30°-34°C.

Electro Diagnostic Procedure

F-wave Studies was performed in all patients clinically diagnosed with cervical radiculopathy on EMG NCV EP Machine, model RMS SALUS 4C. It would be elicited by antidromic activation of motor neurons following peripheral nerve stimulation on the median or ulnar nerve in the upper extremity.

The supramaximal electric stimulus was applied practically at any point along the course of a

nerve elicits the F-wave. Placing the anode distal to the cathode or off the nerve trunk avoids anodal blocking of the antidromic impulse. A surface electrode placed over the motor point of the tested muscle serves as the active lead against the reference electrode over the tendon. An optimal display of F-waves requires an amplifier gain of 200 or 500 μ V/cm and an oscilloscope sweep of 5 or 10 ms/cm, depending on the nerve length and stimulus point.

These recorded parameters truncate and compress the simultaneously recorded M response into the initial portion of the tracing. Different investigators consider different aspects of the F-wave study to be helpful. The most widely used component is the "minimal latency" the latency of the shortest reproducible response. This is assumed to represent conduction time along one of the largest diameter motor fibers in the stimulated nerve.

F-min Latency was compared with previously generated normal values and similar responses from the asymptomatic side.

STATISTICAL ANALYSIS

After performing F-wave studies on patients with radiculitis/radiculopathy, the collected data was analyzed by using two tailed paired student's t-test to calculate mean value, standard deviation, t-sat.value and p-value. In the Implication all the different parameters obtained by F-wave studies on symptomatic side of the patients were compared with asymptomatic side of the same patient. The significance would be defined as $p \leq 0.05$ with standardized test statistics value (t-sat. value) for 34 degree of freedom was 2.03. The diagnostic efficacy was calculated by using Microsoft excel in windows 10.

OBSERVATION & RESULTS

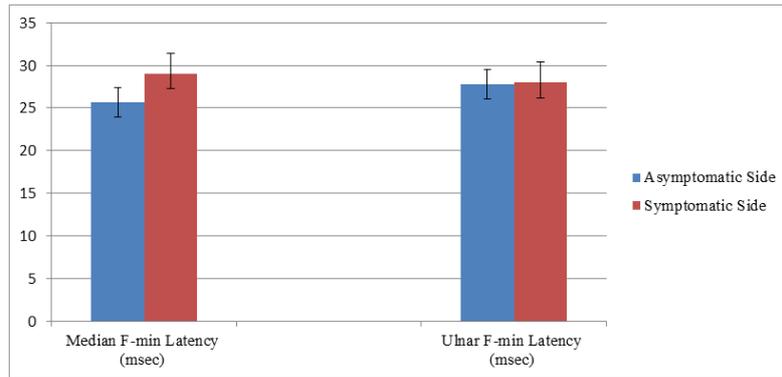
Age and gender wise distribution of all the study subjects is depicted in [Table-1]. Age groups were not statistically different between male and females in study subjects. The mean, standard deviation, test statistics and p-value for median and ulnar nerve is shown in [Table/Fig-2/1]

Table-1: Characteristics of present study in subject of unilaterally affected with cervical radiculopathy

Parameters	Male	Female	P-vale
Number(n)	16	19	-
Age(years)	43.94 \pm 7.12	44.26 \pm 5.76	<0.88

Table-2: Comparison of mean, t. Sat. and p-vale of Median and Ulnar nerve in group –A and group-B

Parameter	Group-A (Asymptomatic Side) (Mean Value ± SD)	Group-B (Symptomatic Side)(Mean Value ± SD)	Student t- test (two-tailed) radiculopathy t stat. value	Student t- test (two-tailed) radiculopathy p value
Median F-min Latency (msec)	25.71±1.70	29.03±2.39	10.77	< 0.0001
Ulnar F-min Latency (msec)	27.77±1.74	28.01±1.79	5.71	< 0.0001

**Fig-1: Comparison of mean value ±SD of F-min Latency in Median and Ulnar nerve in group –A and group-B**

The prolonged mean of F-min latency of median nerve on symptomatic side as compare to asymptomatic side with side to side difference more than 2.0 msec, shows that the F-wave was significantly altered on symptomatic side.

The t-value in all the parameters of median nerve were above 2.03 which was significant in present study, but the difference of t value in median F-min Latency from normal standardized t-value was higher than t value of ulnar F-min Latency it shows the

median F-min Latency was highly significant for the patients of cervical radiculopathy.

The sensitivity, specificity, positive and negative predictive values of F-min Latency is shown in [Table–3]. The diagnostic efficacy for median F-min was obtained to be more sensitive with high positive predicative value. Among various nerves proximal nerves were found to have somewhat greater sensitivity and specificity as compared to distal nerves.

Table-3: Diagnostic efficacy of F-min Latency in group -B:

Nerve Parameters	Sensitivity (%)	Specificity (%)	Positive Predictive Value (%)	Negative Predictive Value (%)
Median F-min Latency	83%	60%	93%	38%
Ulnar F-min Latency	82%	57%	88%	44%

DISCUSSION

In this study analysis of data on basis of increased prevalence of radiculopathy, due to change in lifestyle and heavy weight lifting cause pain in back region with increase duration of same work the weakness and difficulty to perform day to day activities from 3-6 months need to assess the underling progression of disease by recording different parameters of F-wave studies in affected individuals for early diagnosis and to control further progression of the disease.

The F-min latency for median was obtained in present study to be more sensitive of 83% with high positive predicative value of 93% and side to side

difference was more than 2msec in 25 subjects with p value less than 0.0001 showed high significance of F-min latency to manifest secondary/focal slowing due to the loss of the fastest conducting motor axons in patients of cervical radiculopathy.

The obtained result are go ahead in agreement with Puksa L. *et al.* [7], to concluded that the Side to side comparisons of F latency was no significant differences in any of the parameters except for the median nerve F_{min} Latency and F_{mean} Latency, which was 0.2 ms longer on the right than left, if side difference of more than 2 standard deviation was taken as the upper limit for normal, the side difference in arms is 1.4 ms and in legs 3 ms.

These findings are similar to Alvavian-Ghavanini MR *et al.* [8] found that the F wave latency valuable method in evaluation of neurologic disorders, measured F wave value in 50 healthy individual maximum normal F wave latency median nerves was 25.7 for women and 28.5ms for men with stimulation at the wrist. Maximum normal F wave latency for ulnar nerve was 26.45 ms for women and 28.9 ms for men with stimulation at the wrist. It was 23.1 ms for women and 25.3 ms for men with stimulation at the elbow. Maximum normal difference in F wave latency between right and left upper extremities with stimulation at the wrist for total group was 2.2 ms for median nerve and 2.4 ms for ulnar nerve. Maximum normal difference in F wave latency between median and ulnar nerve in an extremity with stimulation at the wrist for total group was 2.7 ms. there was statistically significant difference in F wave latency between women and men.

The present study consisted with the study of T A Kalyon *et al.* [9] found that the F response latency measurements were found to be of value as a diagnostic aid in spinal nerve root compression, can be helpful in confirming some root lesions early in the disease.

The late response was used to directly asses F-wave response on abductor pollicis brevis muscle for median nerve. The F-min latency of median nerve on symptomatic side was delayed because of prolongation in conduction time between the site of the stimulation of the peripheral nerve and the spinal cord (or brainstem in the case of the cranial nerves), for reactivation of the motoneurons (MNs).

SUMMARY AND CONCLUSION

However, in this study with observation and discussion, it is concluded that the F-wave studies are useful supportive diagnostic tool for suspected cervical radiculopathy as they are found to have reliable sensitivity and specificity, among them median nerve F-min Latency is prolonged on symptomatic side is more sensitive and as compared to ulnar nerve F-min Latency.

The present study emphasized that the accurately identifying changes of F-min Latency in radiculopathy provide valuable information that informs treatment, help to establish the diagnosis more definitively and minimizes other invasive and expensive diagnostic and therapeutic procedures.

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