



Utilization of F Waves in the Diagnosis of Carpal Tunnel Syndrome

* Dr NS Bhalerao

Assistant Professor, Department of Medicine , SKNMC and GH, Pune, * Corresponding author

Dr SA Pratinidhi

Professor and Head, Department of Biochemistry, MIMER MC, Talegaon(D).

ABSTRACT

Conventional and comparative electrophysiological testing is useful to diagnose suspected patients of carpal tunnel syndrome. F wave responses testing is routinely performed and are relevant in double crush syndromes like distal Median neuropathy and cervical radiculopathy.

F wave response abnormalities are less stressed for their diagnostic and differential potentials and this study aims to find out prevalence of Abnormal F wave responses in patients with carpal tunnel syndrome.

Methods:- This was a cross sectional observational study at a private diagnostic center. Fifty patients were tested and F wave responses were assessed in ninety seven Median nerves.

Results:- 20% (n=10) of patients showed abnormal F wave responses. 10% (n= 5) patients showed disproportionate F wave abnormality and conventional testing. 10 % of patients showed Abnormal F wave responses associated with cervical radiculopathy. F wave response abnormality shows low sensitivity for diagnosis of carpal tunnel syndrome as well as to rule out double crush syndrome.

KEYWORDS

F wave response, Carpal Tunnel syndrome, Cervical radiculopathy.

Introduction:-

Carpal Tunnel syndrome is a frequently encountered entrapment neuropathy affecting Median nerves at wrist. Most patients with carpal tunnel syndrome complain of paresthesia involving first three digits and sometimes weakness in small muscles of hand, however they may have only vague discomfort or difficulty in performing fine activities. Relevant clinical examination provides useful input to the clinical suspicion of distal Median neuropathy. Detailed Clinical examination followed by electrophysiological testing are the cornerstone of assessment in patients suffering from distal Median neuropathy. Murthy et al reported electrophysiological abnormality in 49% Indian patients with acral paresthesia[1].

Conventional and comparative electrophysiological testing usually suffices for the diagnosis of carpal tunnel syndrome. The association of distal Median neuropathy with coexistent cervical radiculopathy referred to as double crush syndrome is always stressed and nerve conduction study and relevant electromyography will help in proper diagnosis. Cervical radiculopathy patients characteristically show F response abnormalities however the best confirmation comes after electromyography. Overall, the F wave responses in distal Median neuropathy patients may provide a clue for further testing. There are few Indian studies describing F wave response abnormalities in patients with carpal tunnel syndrome and double crush diagnosis [2,5]. F wave responses have been studied broadly for their utility and diagnostic sensitivity [3,4,6]

Methodology: -

A total of 50 consecutive Patients suspected having carpal tunnel syndrome and investigated at A B Diagnostic Center, Pune were included. This was a cross sectional observational study at a polyclinic. Informed consent was obtained from patients before study participation. They were further evaluated for symptoms and signs of carpal tunnel syndrome by detailed history and clinical examination. Adult patients above 18 years with paresthesia in extremities and nocturnal worsening, weakness and wasting of thenar muscles and positive Tinel's and Phalen's sign were included. Patients with traumatic Median neuropathy were excluded.

Routine electrophysiological testing in patients of carpal tunnel syndrome included motor and sensory nerve conduction study of bilateral Median nerves and corresponding Ulnar nerves. Additional comparative testing is performed as necessary [7,8,9].

Electrical stimulation of the distal nerve causes two voltage changes. M response is the first and F waves are the following response. Usually F wave responses are recorded immediately after motor nerve conduction and are long latency responses recorded from most of the extremity nerves. This response is indicative of anterior horn cell depolarization resulting due to antidromic stimulation of motor nerve fibres. They are called F waves because initially they were recorded from foot muscles. Hand in which the test is initiated is kept rested in supine position. For Median nerve, abductor Pollicis Brevis muscle is selected and active electrode is placed on its motor point and reference electrode is placed three cm proximally at base of thumb.

Using a supramaximal electrical stimulus, a series of ten stimuli are recorded. These traces are scanned for parameters like M wave latency, Min F wave latency (FWML), F wave chronodispersion (difference between Minimum and maximum F wave latency) and persistence of F wave response. Minimal F-wave latency is the parameter utilized for comparison as it is most consistently found useful. All patients in our study underwent testing at appropriate conditions on a Viking quest 4 channel ENMG machine (Nicolet). F wave responses were categorized into presence of response with normal Minimum F latency, prolongation of Minimum F wave latency (>31.0 ms) and absent response. This study aimed to find out the prevalence of F responses abnormality of Median nerves in a cohort of carpal tunnel syndrome patients with special emphasis on Min F wave latency [10,11].

There are different scales utilized for grading severity of carpal tunnel syndrome electrophysiologically. In this study, Bland's electrophysiological scale was used [12]. This scale classifies carpal tunnel syndrome in six categories, 1 being very mild and 6 is extremely severe.

Results:-

A total of 50 patients of carpal tunnel syndrome referred for electro-diagnostic services at A B Diagnostic Center were screened for bilateral Median nerve testing. Out of them, three patients were evaluated on symptomatic side only and could not tolerate contralateral Median nerve testing. Overall, 97 Median nerves underwent electrophysiological testing. Nerve conduction study of Median motor and sensory responses was performed in these patients and 33 patients underwent electromyography (EMG). Double stimulation at wrist clinched the diagnosis in six patients for one patient bilaterally, another for symptomatic unilateral Median nerve while in rest for other Median nerve when contralateral side showed distal Median neuropathy by conventional testing.

Demographic features: The demographic profile of these patients was as in Table 1. Mean age of patients in this study was 43.9± 11.7 years and age range was 20-70 years (Figure 1). This study population had female predominance (41F: 9M) (Figure 2). Sixteen patients were actively working either at office or were running their business. Twenty three were engaged in household activities and of them four were doing household chores for others. Three were students and eight patients were sedentary looking after their personal activities of daily living independently. Five patients were asymptomatic for symptoms of Median nerve entrapment and were detected incidentally after electrophysiological study. The demographic profile of these patients is given in Table 1.

Electrophysiology parameters: Electrophysiology results were summarized in Table 2. Bilateral Median motor and sensory nerve conduction parameters were comparable. Abnormal F response was seen in 10 patients (20%) and in 12 nerves; prolonged Minimum F latency in 14% nerves and absent F response in 10% patients. There were 10% of patients in whom F wave abnormality in the form of absent response was disproportionate to routine conduction studies. 10% of patients showed double crush syndrome i.e. coexistent carpal tunnel syndrome and cervical radiculopathy. Abnormal EMG was seen in 38% (n= 19) of patients. 14 % (n=7) showed active denervation and 24 % (n=12) of patients revealed reduced recruitment with polyphasic potentials.

Severity of Carpal tunnel syndrome: As seen in Table 3 we have done Electrophysiological Grading of Carpal Tunnel Syndrome Patients. From the total cohort of fifty Carpal Tunnel syndrome patients, 97 median nerves were tested. Out of them 44 median nerves had mild severity of carpal tunnel syndrome, 41 median nerves had moderately severe subtype and severe in 12 median nerves. Patient with F response abnormality had mostly moderately severe, sub type of Carpal Tunnel syndrome. Only 10% of patients had disproportionately abnormal F wave response compared to conventional electrophysiological methods of carpal tunnel syndrome testing. Co-existent Cervical Radiculopathy: Double crush syndrome was seen in 10% (n=5) of patients and they showed prolonged Min F latency in this cohort.

Discussion:-

Carpal tunnel syndrome is a common entrapment neuropathy in clinical practice. [1]. Detailed clinical evaluation has to be usually followed by electrophysiological testing and proper algorithm to be practiced. Though routine Median motor and sensory nerve conduction studies are valuable, additional information can be gained by additional testing like F wave responses.

The present study population had female predominance as seen in other studies (82% vs. 18%). Carpal tunnel syndrome affects females predominantly [2,5]. Maximum patients of carpal tunnel syndrome in our study were in the fourth decade. Right hand was more commonly affected in our study similar to existing literature [1,13]. F wave abnormalities have low sensitivity for diagnosis of carpal tunnel syndrome as seen in other studies [2,5]. Severity grading of carpal tunnel syndrome in our study correlated with other studies [13]. Double

crush or coexistent cervical radiculopathy with carpal tunnel syndrome also showed low sensitivity that was an expected. There are limitations to this study that low sample size. These observations have to be replicated with prospective studies of large sample size. There is additionally a referral bias because the cohort is collected from convenient sampling.

Conclusion:-

Carpal Tunnel syndrome is commonly occurring mononeuropathy in electrophysiological diagnostic studies. There are limited studies co relating F wave abnormality with severity grading of the distal median neuropathy. The present study tried to correlate F wave responses with diagnosis of Carpal Tunnel syndrome and coexistent cervical radiculopathy. F wave abnormality though easy to perform has low sensitivity for both diagnosis of carpal tunnel syndrome and double crush syndrome. Judicious use of F wave responses in patients with Carpal Tunnel syndrome will help in better clinical management of patients.

Figure 1: F waves in Carpal Tunnel Syndrome (CTS)

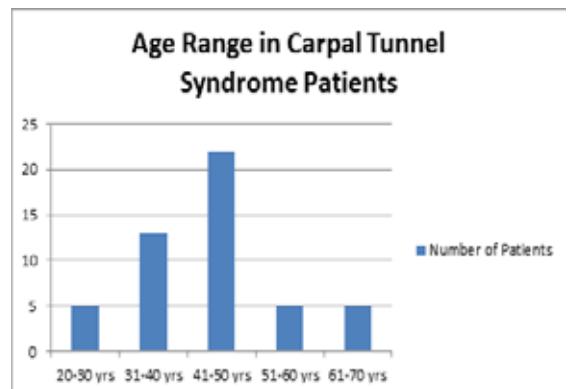


Table1: Demographic Features in Carpal Tunnel Syndrome Patients

Variable	Value (n=50)
Age in years (Mean± SD)	44.8 ± 11.6 years
Gender (M: F)	9:41
Bilateral CTS	38
Symmetrical	23
Asymmetrical	15
Unilateral CTS	12
Right side only	10
Left side only	2
Co-morbidities	
Diabetes Mellitus	3
Hypothyroidism	3
Arthritis	4
Associated other neuropathy	5
Postpartum	1
Others	2
Idiopathic	32

Figure 2: Gender wise Distribution of Carpal Tunnel Syndrome Patients

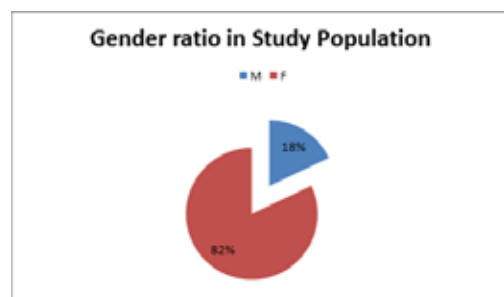


Table 2: Electrophysiological Parameters in Median nerves of Patients with Carpal Tunnel Syndrome

Parameter (Mean ± SD)	Median Motor left (n=48) two asymptomatic nerves could not be tested	Median Motor right (n=49, one asymptomatic nerve could not be tested)	Median Sensory left (n=44, absent response in 4 patients, two could not be tested)	Median Sensory right (n=48, absent response in 2 patients)
Latency (ms)	4.66±2.1	4.74±1.66	3.53±0.9	3.75±0.9
Amplitude (mV for motor/ µV for sensory)	8.18±3.57	8.77±3.29	39.45±21.03	32.69±17.15
Conduction Velocity (m/s)	50.64±6.68	50.39±7.4	41.58±8.52	39.61±7.82

Table 3: Electrophysiological Grading of Carpal Tunnel Syndrome Patients

Grade of Carpal Tunnel Syndrome	Number of Patients
1	9
2	35
3	31
4	10
5	10
6	2

References:-

- Murthy JMK, Meena AK. Carpal tunnel syndrome- Electrodiagnostic aspects of fifty seven symptomatic hands. *Neurology India*, 1999; 47: 272-275
- Joshi AG, Gargate AR. Diagnostic utility of F waves in clinically diagnosed patients of carpal tunnel syndrome *Indian J Physiol Pharmacol* 2013; 57 : 372-377
- Mohammad Yazdchi, Reza Khandaghi, MA Arami. Evaluation of F-wave in carpal tunnel syndrome and its prognostic value: *Journal of neurological sciences (Turkish)*, 2005; Vol. 22: 1-5.
- Frank Weber. The diagnostic sensitivity of different Fwave parameters. *J Neural Neurosurg Psychiatry* 1998; 65: 535-540
- Ashraf Husain, Syed Omar, Abdul-Majeed Al-Drees. F ratio, a surrogate marker of carpal tunnel syndrome. *Neurosciences* 2009; Vol. 14(1): 19-24.
- Daniel L. Menkes, Daniel C. Hood, Anneke C. Inversion of the F-waves in median neuropathy at wrist (carpal tunnel syndrome). *Neurology and Clinical Investigations* 1997;1-8.
- AAEM: Practice parameter for electrodiagnostic studies in carpal tunnel syndrome: summery statement. *Muscle Nerve*, 2002; 25: 918-922.
- Practice parameter for electro diagnostic studies in carpal tunnel syndrome (summary statement). American Academy of Neurology, American Association of Electrodiagnostic Medicine, and American Academy of Physical Medicine and Rehabilitation. *Neurology* 1993; 43: 2404-2405.
- AAEM: Practice parameter for electrodiagnostic studies in carpal tunnel syndrome: summery statement. *Muscle Nerve*, 2002; 25: 918-922
- Ross MA, Kimura J. AAEM case report #2: the carpal tunnel syndrome. *Muscle Nerve* 1995; 18; 567-573.
- Young RR, Shahani BT. Clinical value and limitations of F-wave determination. *Muscle Nerve* 1978; 1: 248-250
- Bland JD. A neurophysiological grading scale for carpal tunnel syndrome.
- Muscle Nerve* 2000;23:1280-3.
- Meena AK, Demudu BB, Umamahesh, Sailaja S., Padmaja D., Borgohain R. Comparison of high resolution sonography and electrophysiology in the diagnosis of carpal tunnel syndrome. *Ann Indian Acad Neurol*: 2015;18:219-225.