

# To Study the Effect of Nerve Conduction Studies on Patients of Cervical Radiculopathies/Radiculopathy

Nikita Yadav<sup>1</sup>, Garima Bafna<sup>2\*</sup><sup>1</sup>M.Sc Student, Department of Physiology, JLN Medical College, Ajmer, Rajasthan, India<sup>2</sup>Professor and Head, Department of Physiology, JLN Medical College, Ajmer, Rajasthan, India

\*Corresponding author: Garima Bafna

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## Abstract

Radiculopathy is a mechanical compression of a nerve root usually at the exit foramen or lateral recess. Cervical radiculopathies (CR) was conditions involving a pathological process affecting at or near the root of the nerve, shortly after its exit from the upper back spine. 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. *Aim* of present study to evaluate diagnostic utility of nerve conduction studies in 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 reduced CMAP of median had shown significant variation on symptomatic side as compare to asymptomatic side. These variations in side to side nerve conduction parameters by non-invasive technique brings awareness to clinicians about the radiculopathy and this report may also be useful to clinician for early diagnosis of cervical radiculopathy.

**Keywords:** Cervical radiculopathies (CR), magnetic resonance imaging (MRI), Compound muscle action potential (CMAP).

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## INTRODUCTION

Radiculopathy is a mechanical compression of a nerve root usually at the exit foramen or lateral recess. A nerve root impingement in the neck can produce pain, weakness numbness and loss of reflexes in the forearm by "wear and tear" changes that occur in the spine as we age, such as arthritis. In younger people, it is most often caused by a sudden injury that results in a herniated disk, degeneration of the spinal vertebra and narrowing of the foramen from which the nerves exit the spinal canal known as cervical radiculopathy [1]. The initial inflammation associated with nerve root is defined as radiculitis [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. A more recent study from the US military found an incidence of 1.79 per 1000 person-years. The incidence of cervical radiculopathy seems to peak in the fourth and fifth decades in life [3].

Other etiology factors for radiculopathy is spinal stenosis resulting from a combination of degenerative spondylosis, ligament hypertrophy, spondylolisthesis and inflammatory radiculitis can also cause radiculopathy by pathophysiological process [4]. 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 and lumbar radiculitis/radiculopathy was time consuming and costly, while Nerve conduction studies was cost effective, non-invasive and feasible to be used as early diagnostic tool by side to side variations in various motor and sensory nerve conduction study parameters in cervical radiculopathy.

Nerve conduction Studies were performed to understand the pathophysiology of radiculopathy and conduct the study in a practical manner that optimizes its diagnostic yield. NCS 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. Therefore, the aim of present study was to evaluate diagnostic utility of nerve conduction studies in patients of cervical radiculitis/radiculopathy.

## MATERIALS AND METHODS

A randomized paired-study design was utilized to evaluate nerve conduction studies elicited with median and ulnar nerves by motor and sensory nerve 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

Nerve conduction studies (NCS) was performed in all patients clinically diagnosed with cervical radiculopathy on EMG NCV EP Machine, model RMS SALUS 4C. Surface disc electrode was placed on corresponding muscles. Ground electrode was placed between stimulating and recording electrodes. Belly tendon montage was used with cathode and anode 3 cm apart. Filters were set at 2 Hz to 5 kHz and sweep speed was 5 ms per division for motor study and for sensory study, filters were at 20 Hz to 3 kHz and sweep speed was 2 ms per division. Duration for both motor and sensory study was at 100  $\mu$ s. Parameters like Distal Motor Latency (DML), Compound muscle action potential (CMAP) amplitude Conduction Velocity (CV) were evaluated for motor nerves.

Sensory conduction study (antidromic) involved stimulation of sensory nerves proximally and recording Sensory Nerve Action Potential (SNAP) with electrodes placed distally over the dermatomic distribution. Distance between active electrode and cathode of stimulator was divided automatically by onset latency (the time between a stimulus and the appearance of a response, when motor nerve fibers were stimulated close to the muscle. It includes both the duration of time that it takes the nerve to conduct from the point of stimulation to the motor end plate area and the duration of time for the neuromuscular junction transmission to activate the muscle measured in milliseconds) to give sensory conduction velocity. SNAP amplitude was taken from peak to base. Sensory nerves tested were Median and Ulnar nerves. Parameters like sensory latency, SNAP amplitude and conduction velocity were evaluated for sensory nerves.

Distal latencies, amplitude and conduction velocity were compared with previously generated normal values and similar responses from the asymptomatic side.

### Statistical analysis

After performing nerve conduction studies on patients with radiculitis/radiculopathy, the collected data was analyzed by using two tailed paired statistical student's t-test to calculate mean value, standard deviation, t-stat. value and p-value. In the Implication all the different parameters obtained by nerve conduction 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-stat. value) for 34 degree of freedom was 2.03. The diagnostic efficacy was calculated by using Microsoft excel in windows 10.

## OBSERVATIONS & RESULTS

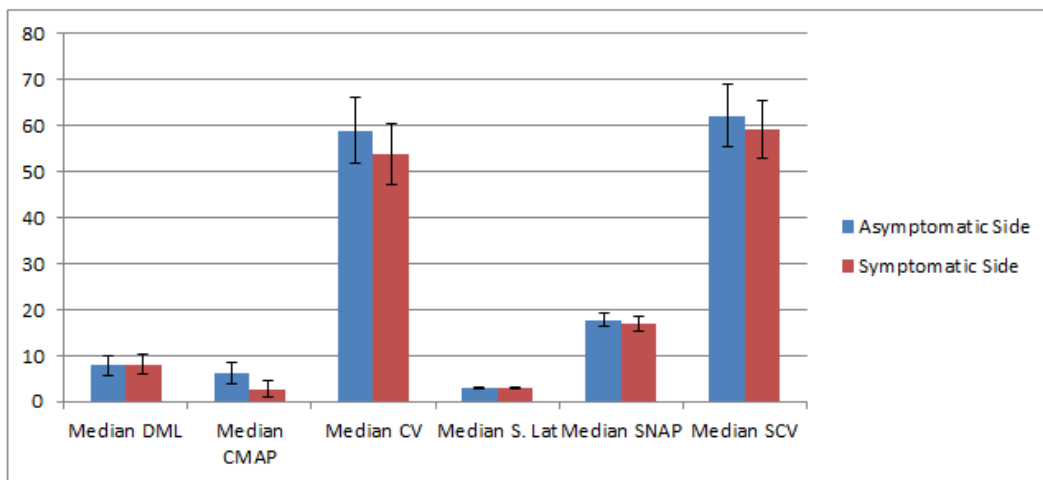
Age and gender wise distribution of all the study subjects is depicted in [Table-1]. Age groups were not statistically different between male and females in study subjects. The mean, standard deviation, test statistics and p-value for median and ulnar nerve is shown in [Table/Fig-2/1 and Table/Fig-3/2]

**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 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 DML(msec)	7.8±2.03	8.12±2.03	4.83	< 0.0001
Median CAMP(mv)	6.23±2.36	2.65±1.11	13.43	< 0.0001
Median Motor CV(m/s)	58.9±1 7.17	53.75±6.64	7	< 0.0001
Median Sensory latency (msec)	2.94±0.18	3.09±0.24	5.05	< 0.0001
Median SNAP (µv)	17.79±1.48	16.98±1.49	5.35	< 0.0001
Median S CV (m/s)	59.16 ±6.25	62.81±6.77	4.99	< 0.0001



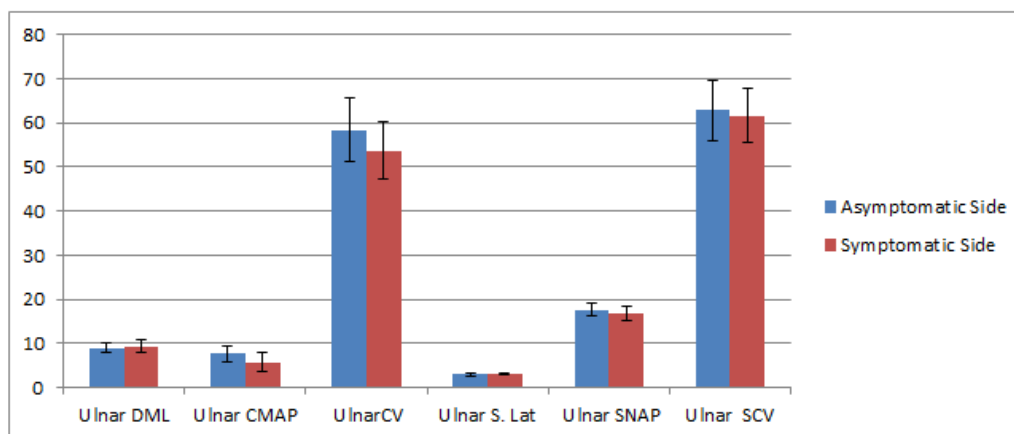
**Fig-1: Comparison of mean value ±SD of in all parameters of Median nerve in group –A and group-B**

The p-value in all the parameters of median nerve were statistically significant (P<0.0001) in both Group A (asymptomatic side) and Group B (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 CMAP from normal standardized t-value was higher than t value of other parameters it shows the median CAMP was highly significant for the patients of cervical radiculopathy.

**Table-3: Comparison of mean, t. Sat. and p-vale of 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
Ulnar DML (msec)	8.99±1.06	9.33±1.40	6.02	< 0.0001
Ulnar CAMP (mv)	7.68±1.81	5.79±2.24	6.44	< 0.0001
Ulnar Motor CV (m/s)	58.43±7.17	53.7±6.69	7.64	< 0.0001
Ulnar Sensory Latency (msec)	2.94±0.33	3.10±0.35	5.59	< 0.0001
Ulnar SNAP (µv)	17.66±1.50	16.71±1.70	5.49	< 0.0001
Ulnar Sensory CV(m/s)	62.81±6.77	61.64±6.17	4.99	< 0.0001



**Fig-2: Comparison of mean value ± SD of in all parameters of ulnar nerve in group –A and group-B**

The result obtained from above table was determined that the mean of different parameters in ulnar nerve on both the sides was within normal limits.

The sensitivity, specificity, positive and negative predictive values of motor and sensory nerve conduction study is shown in [Table-4]. Among various motor nerve conduction parameters CMAP was found to be more sensitive with high positive

predictive value. CV was found to have greater specificity and DML had least negative predictive value. Among various nerves proximal nerves were found to have somewhat greater sensitivity and specificity as compared to distal nerves. Sensory nerve conduction parameters were found to have less sensitivity but higher specificity as compared to motor parameters. Positive and negative predictive values were comparable to motor parameters [Table-4].

**Table-4: Diagnostic efficacy of motor nerve conduction Parameter in group -B:**

Nerve Parameters	Parameters	Sensitivity (%)	Specificity (%)	Positive Predictive Value (%)	Negative Predictive Value(%)
Median	DML	43%	67%	71%	38%
	CMAP	90%	50%	93%	40%
	CV	48%	64%	69%	43%
Ulnar	DML	47%	81%	75%	57%
	CMAP	55%	67%	75%	44%
	CV	41%	80%	64%	62%

## 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 needed to assess the underlying progression of disease. It was recorded by using different parameters of nerve conduction studies in affected individuals for early diagnosis and to control further progression of the disease.

The study demonstrated that, the significant reduction in CMAP, slightly delayed distal motor latency with decreased conduction velocity on symptomatic side as compare to asymptomatic side. The obtained results correlated with previous studies, which reported that changes in nerve conduction parameters in patients who were suspected with cervical radiculopathy to verify the presence and severity of radiculopathy [5, 6].

The existent study contribute that the significantly reduction ( $p < 0.0001$ ) in CMAP of median was less than half on symptomatic as compare to asymptomatic side. The diagnostic efficacy of CMAP was 90% sensitive with 93% positive predicate value, CV was 64% specificity and DML was 38% of negative predictive value. Sensory nerve conduction parameters were found to be less sensitivity but higher specificity with positive and negative predictive values were comparable to motor parameters it determine the axonal loss with functionally intact myelin sheath.

The present study consisted with the study of A Mallik *et al.* [7]. According to their study, the NCS in axonal loss abnormality was determined by reduction in CMAP amplitude and if fewer functioning motor axons were connected to muscle fibers with myelin was unaffected; the remaining axons conduct normally then expected latencies and conduction velocities to remain normal. In case increasing motor axon loss some of the largest fastest conducting fibers would be lost, therefore distal motor latency may be slightly prolonged (120% of normal limit) and conduction velocity slightly

slowed (80% of normal limit), and in case of axonal pathology.

These findings are similar to S. Pawar *et al.* [10] reported that the nerve conduction studies were useful supportive diagnostic tool for suspected cervical radiculopathy as they were found to have reliable sensitivity and specificity, and various motor nerve conduction parameters CMAP was found to be more sensitive with high positive predicative value, CV was found to have greater specificity and DML had least negative predictive value. Sensory nerve conduction parameters were found to have less sensitivity but higher specificity as compared to motor parameters.

Distal motor latency, compound muscle action potential and conduction velocity were the parameters for assessment of radiculopathy in affected individuals. Of these, compound muscle action potential was the most widely used indicator for radiculopathy because of ease to recording and increased gap analysis seen in comparison of both the limbs. In motor nerve conduction parameters, the CMAP were reduced on symptomatic side in patients of radiculopathy because of reduce number of viable motor axons supplying to the affected muscle. Therefore reduced CMAP was indicator of early detection in patients of unilaterally affected with radiculopathy and expeditious correction of it is likely to be the most effective intervention for preventing radiculopathy.

The distal motor latency and conduction velocity preserved normal because they reflect conduction along surviving fibers that were conducting at their normal rate, it might alter in extreme demyelination of axons.

A sensory nerve conduction (SNC) study for median and ulnar nerve was normal in nerve root injuries sparing dorsal root ganglion as disc herniations were distal to it. The present study shows abnormal median and ulnar SNC studies in 9 and 7 subjects and 26 subjects were exhibit normal sensory nerve conduction parameter with higher specificity.

The present finding of existent study resembles with studies of T.R. Dillingham *et al.* [11] mentioned that the electrodiagnostic examination was the most important means of testing for the evaluation of patients with suspected radiculopathy; this test has modest sensitivity but high specificity, severe axonal damage intra spinally results in reduced compound muscle action potentials (CMAPs). However, the sensory nerve action potentials (SNAPs) were preserved normal.

The sensory parameters were altered that means lesion was post ganglionic or with severe axonal degeneration secondary to severe and chronic compression of nerve root and the sensory nerve

conduction parameters was normal that means lesion was preganglionic or compression occurs proximal to the dorsal root ganglion, which was distal most aspect of neural foramen.

## SUMMARY AND CONCLUSION

However, in this study with observation and discussion, it is concluded that the nerve conduction studies are useful supportive diagnostic tool for suspected cervical radiculopathy as they are found to have reliable sensitivity and specificity, among them motor nerve conduction parameters the compound muscle action potential reduced less than half on symptomatic side is more sensitive and as compared to distal motor latency and conduction velocity. The sensory nerve conduction parameters are less sensitive in diagnosing cervical radiculopathy.

The present study emphasized that the accurately identifying changes of nerve conduction parameters in radiculopathy provide valuable information that informs treatment and minimizes other invasive and expensive diagnostic and therapeutic procedures. Although the size of sample was not appropriate according the prevalence rate of radiculopathy in Rajasthan yet know the effect, I have done this study. The appropriate diagnosis of radiculopathy is assesed with combination of nerve conduction studies and electromyography for further aspect.

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