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EFFICACY OF CERVICAL NERVE TENSION ASSESSMENT SCREENING TOOL AMONG SUBJECTS WITH CERVICAL RADICULOPATHY

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ABSTRACT:

Background *In cervical radiculopathy inflamed and damaged nerve roots alters the neurological function. Numbness, weakness, radiating pain from neck to shoulder, arm, hand or fingers. Electro diagnostic studies plays crucial role to diagnose disorder of nerve and muscle but it is expensive and has a large set up. Portable nerve conduction devices are very easy to use, simple and inexpensive, cost effective means of measurement. There are very limited scales of android application and portable screening tool for nerve conduction study .**Aim and objectives** 1. To study and find the efficacy of cervical nerve tension assessment screening tool among subjects with cervical radiculopathy.2 To compare the readings of ulnar and median nerve conduction velocity by using newly developed cervical nerve tension assessment screening tool with the conventional electro diagnostic device on healthy as well as cervical radiculopathy subjects **materials and methodology** There were 124 participants they were allocated into two group with 62 participants each. Group A was of subjects with Cervical Radiculopathy and group B was of healthy individuals and they were diagnosed by standard existing NCS device and simultaneously by newly developed screening tool which is portable. Nerve conduction and latency were outcome measures in both devices for median and ulnar motor nerves. At the end data were analysed and the values of new device were compared with existing device to check the accuracy. **Result:** There is a perfect and significant correlation was observed between Existing and Portable devices in all parameters. Value for median and ulnar nerve latency and conduction velocity in both the groups is <0.001 meaning very significant. **Conclusion** Cervical Nerve Tension Assessment Screening Tool among Subjects with Cervical Radiculopathy can be alternative to the existing NCS device. The readings of cervical nerve tension assessment screening tool matches with the standard existing device of NCS.*

Keywords *Electro diagnosis, physiotherapy, Portable, Cervical Radiculopathy, Conduction velocity.*

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I. INTRODUCTION:

In Cervical Radiculopathy patients come up with sharp pain and tingling pain or burning sensation. There may be sensory-motor dysfunction and reflex activity may be diminished. Patient typically complains of neck pain and arm pain. In some cases diagnostic testing is advised like Magnetic Resonance Imaging

(MRI) ,X-ray. CT scan, Electro diagnostic testing like electromyography, Nerve conduction study are important, useful supportive diagnostic tool for the cervical radiculopathy patients, As it gives reliable and specific information about the condition[1]. Nerve conduction study measure nerve and muscle function. NCS studies are important to evaluate and investigate paresthesia (Numbness, Tingling, and Burning) or weakness of arms, legs. NCS plays crucial role to diagnose disorder of nerve. NCS measures how fast an electrical impulse moves through the nerve[1].

Recent advancement in the technology have given an opportunity for the development of digital, portable, Inexpensive systems to analyze the data with the help of smartphone and software application. Portable devices shown good capability and decreasing the cost of biomedical signals. Nowadays mobile health applications are used for data collection, education and medical services. E-Health is mobile health (mHealth) which gives health information and services via mobile phone technology and device which are portable and wireless[2.] Available electro diagnostic portable devices in the market are NC Stat (Neurometrix) , Mediracer , NervePace or Brexio, Neurosentinel , Axon II ,Neurometer etc[3].The conventional set up is costlier. Lack of availability of special room for the placement of equipment, trained neurophysiologist then the system will be of no use. Hand held devices are gives potential advantage over existing device. Testing can be quick and easy to perform. It can be performed by any health care professional. Device can be used on outpatient department (OPD) basis where quick examination can be done for the appropriate diagnosis without wasting time for further examinations[2, 4,5] So this study was taken into consideration.

II. MATERIAL AND METHODS

This analytical study was carried out in department of Physiotherapy in Krishna institute of medical sciences, Karad during 2019-2020. After approval from the institutional ethical committee, Subjects of age group 40 to 65 years who were willing to participate irrespective of their gender, individuals with radicular symptoms along with the sensory or motor deficit in upper limb as well as positive upper limb nerve tension test were included in the study. Subjects from both the groups were assessed by Upper limb Nerve Tension Test, MMT, dermatome examination.

Therapist screened participants and then enrolled them in the study.There were 124 participants in the study and they were divided into two groups Group A and Group B each with 62 participants each. Group A was of subjects with CR who were assessed by standard existing NCS device and simultaneously by newly developed cervical nerve tension assessment screening tool which is portable; Group B was of healthy individuals without any radicular symptoms. They were also investigated by both the devices. Nerve conduction and latency were taken into consideration in both devices for median and ulnar motor nerves .At the end data were utilized and the values of new device were compared with existing device to check the accuracy.

Subjects were excluded if they exhibit cervical thoracic vertebrae fracture, Carcinoma, Open wound or skin ulcers in and around neck. Informed consent was taken from the participants prior of the study. Sample method used in study was consecutive sampling. The sample size was calculated by using nMaster 2.0 software. Statistical analysis was done by using Chi-square, by Karl Pearson's correlation coefficient method, Weighted Kappa statistics, dependent t test and the software used in the analysis was SPSS 22.0 version. P<0.05 is considered as level of significance.

III. RESULTS

62 Participants were recruited in each group.27 male and 35 females were included in group A diagnosed with CR. 30 males and 32 females were included in group B i.e Healthy control group who don't possess CR symptoms. The study included participants between the age group of 40 to 65 years. According to the data collected 99.4 % subjects complained of arm pain, 85.2% had sensory deficit and 80.1 % had neck pain, 71.2% had reflex deficit and 88% had motor deficit. 52.5% had scapular pain and 13.1% had chest pain. Neurologic deficit corresponded with the offending disc level is approximately 80%.All parameters scores in two devices (Existing and Portable) in both the groups follow a normal distribution,

Parameters in two device follow normal distribution .Correlation between two devices for median and Ulnar nerve latency and CV scores were measured in groups (A and B) by Karl Pearson's correlation coefficient method. P value for median and ulnar nerve latency in both the groups is <0.001 meaning very significant. There is significant correlation was observed between all parameters in both the groups. It means that, portable screening tool is producing a similarity in their values as compared to existing device

1.CORRELATION TEST by Karl Pearson's correlation coefficient method

	GROUP A		**GROUP B**	
Correlation between	**t-value**	**P value**	**t-value**	**p-value**
existing and portable device	31.419	0.001	25.59	0.001
Existing and portable device	49.85	0.001	54.40	0.001
Existing and portable device	36.6	0.001	15.12	0.001
Existing and portable device	69.39	0.001	45.03	0.001
P< 0.05*				

Correlation between two devices (Existing and Portable) with median and Ulnar nerve latency and conduction velocity scores in groups (A and B) by Karl Pearson's correlation coefficient method

Agreement between two devices with median and Ulnar nerve latency and CV scores in groups (A and B) by Weighted Kappa statistic which suggests P value for median and ulnar nerve latency and CV for both the groups A and B is <0.001.

2.Agreement between two devices

		GROUP A		GROUP B	
Nerve	**Agreement between**	**agreement**	**P value**	**agreement**	**P value**
MEDIAN LATENCY	existing and portable device	93.94%	0.001	93.61	0.001
MEDIAN CV	Existing and portable device	96.02	0.001	96.75	0.001
ULNAR LATENCY	Existing and portable device	94.74	0.001	89.85	0.001
ULNAR CV	Existing and portable device	96.81	0.001	96.73	0.001
P>0.05					

Agreement between two devices (Existing and Portable) with median and Ulnar nerve latency and conduction velocity scores in groups (A and B) by Weighted Kappa statistic.

Comparison of two devices for median nerve latency and CV were measured in group A by dependent t test. Mean± SD was 5.32± 2.05 by existing device and 5.24± 2.05 by portable screening tool p value 0.22 for median nerve latency. Mean ±SD in existing device for median nerve CV was 44± 10.86 and in portable screening tool it was 43.77± 10.9 with p value 0.28. Ulnar nerve latency and CV scores were compared from the both devices in group A by dependent t test Mean± SD was 5..84± 2.11.by existing device and 5.97± 2.18 by

portable screening tool p value 0.02 for ulnar nerve latency Mean ±SD in existing device for ulnar nerve CV was 49.95± 11.73 and in portable screening tool it was 48.92± 11.56 with p value 0.002 Comparison of two devices for median nerve latency and CV scores were done in group B by dependent t test. Mean± SD was 5.29± 1.64.by existing device and 5.35± 1.60 by portable too with value 0.26 for median nerve latency. Mean ±SD in existing device for median nerve CV was 59.52± 8.38 and in portable screening tool it was 58.81± 8.13 with p value 0.0001

3.comparison of two device in group A by dependent t test for median and ulnar nerve

Outcome measure	**device**	**Median mean±SD**	**P value**	**Ulnar mean±SD**	**P value**
Group A	Existing NCV	5.32±2.05		5.84±2.11	
LATENCY			0.2214		0.0263
	portable NCV	5.24±2.05		5.97±2.18	
	Existing NCV	44±10.86		49.45±11.73	
CV			1.0737		0.002
	Portable NCV	43.77±10.91		48.92±11.56	
*P<0.05					

Comparison of two devices for latency and conduction velocity scores in group A by dependent t test

4.comparison of two device in group B by dependent t test for median and ulnar nerve

Outcome measure	**device**	**Median mean±SD**	**P value**	**Ulnar mean±SD**	**P value**
Group B	Existing NCV	5.29±1.64		3.79±1.17	
LATENCY			0.2635		0.02486
	portable NCV	5.35±1.60		5.71±1.23	
	Existing NCV	59.52±8.38		59.39±8.02	
CV			0.0001		0.0271
	Portable NCV	58.81±8.13		59±7.87	
*P<0.05					

Comparison of two devices for latency and conduction velocity scores in group B by dependent t test

IV. DISCUSSION

The present study was conducted to check the efficacy of cervical nerve tension assessment screening tool among subjects with CR. Investigation of NCV on subjects with CR was done with the help of standard NCS device and the portable screening tool. Readings of the median and ulnar motor nerves were compared with the standard NCS device to check the accuracy level of the new screening tool.

Study done by Isam Atroshi, MD , Haddelholm " Evaluation of portable nerve conduction testing in the diagnosis of carpal tunnel syndrome(CTS)". They said the portable testing instrument (electroneurometer) was investigated to evaluate its sensitivity and specificity in the diagnosis of CTS. Sensitivity of the portable device was 58% for motor latency and 65% for sensory latency. Specificity of the instrument in control hands was 87% and 92% for motor and sensory latency respectively. The sensitivity and specificity of the devices are comparable to those reported in conventional nerve conduction studies[6]

Bruce A. PeGreewal, conducted a study on Validation of a Novel Point of care Nerve conduction Device for the detection of diabetic polyneuropathy. This device can used by non-technical person. 72 patients with diabetes were evaluated by standard device and point of care device for sural nerve function. Sural nerve amplitude potentials measured by the point of care device shared very strong correlation with reference standard device ($p < 0.001$)[7.]

So in present study we have developed the very easy and handy device which can be used by everyone with clear understanding of device and can be move from one place to other.

In clinical practice when patient comes to physiotherapist with radicular symptoms Nerve tension test are being performed by the therapist. But the severity of the damaged nerve conduction velocity cannot be assessed. Then patient is asked to do electro diagnostic testing for early diagnosis and early prognosis which is sometimes not affordable and inconvenient to the patient. So patient likely to avoid this long term procedure and may continue or discontinue the therapy and so delay in further intervention. Commonly the setup of the Electro diagnostic lab is not cost effective. Portable version of the same device can be available then it will be more convenient for the doctors and patients too .Due to lack of knowledge of portable NCV device and their benefits this field of area is hindered.

Karimpur M, Parsaei H, Roxana Sharifian, Yazdani: An Android Application for Estimating Muscle Onset Latency using surface EMG signal. The objective of this study was to develop non expensive and portable android application for estimating muscle onset latency via analyzing surface EMG. Muscle onset latency values estimated using the presented app are the statistically equal to those commercial windows based surface EMG analysis software. Recent advances in smart portable devices such as mobile phones have shown great capability of facilitating and reduced cost of analyzing[2.] In current study Along with this device to get the data output an android software or application is been developed which shows the data on our android application.

Sumit Majumder, M Jamal Deen. : Smartphone Sensors for Health Monitoring and Diagnosis in this discussed about the new technology and health related to smart phone. In our device NCV sensors, electro-magnetic coils are generated which collects the information from the nerve through the NCV electrode and gives the output on android application[8]. To get rid of wire, Channels or cables Bluetooth connectivity plays important role. It is inexpensive, enabling of compelling application and universally adopted by vendors. The use of Bluetooth connectivity in medical field is miracle[9]

In 21st century everyone is aware of new technologies. Most of the people use smart phones, touch screen and various applications. So will be designing the screening tool in which recordings of NCS will be measured with portable device and data will be displayed on the mobile phone which is connected to portable device via Bluetooth. So in clinical set up we can Use software which will store large amount of data and give accurate information. This diagnostic information will be helpful for directional preference and activity specific spinal stabilization exercises have significant effect on pain and spinal mobility in lumbar spondylosis[10] and early intervention of physiotherapy for Acute Intervertebral Disc Prolapse[11] and chronic back pain.[12] For Evidence based therapeutic exercise program development this type of diagnostic tool will be usefel[13]

In our study we have done investigation of CR subjects. On same subject the NCS investigation done by the both the device to check the accuracy level of portable screening tool.; The standard existing device and the invented portable nerve tension assessment screening tool. This study suggested that There is perfect and significant correlation was observed between existing and portable screening tool in the parameters like latency and nerve conduction velocity.

There are many portable electro diagnostic devices in the market are NC Stat (Neurometrix) , Mediracer , NervePace or Brexio, Neurosentinel , Axon II ,Advance NCS, Neurometer etc. All work amazingly for the diagnosis of the nerve entrapment syndrome. In present study we have developed the software along with device so that all the readings can be taken on the smartphone itself. In above all the devices USB portable is attached to collect the data from the monitor. But in our study we can get data in wireless manner by using Bluetooth connectivity.

Novelty of the device is we can conduct electro diagnostic testing for any nerve and large number of data can be stored in the application and can be immediately send or shared to patient's mobile number. So this digitalized system saving the time, paper and money. The mentioned above companies of portable electro diagnostic testing devices are not easily available in India and its cost also not affordable in our society. So our device will be really helpful and cost effective. In present study we have used disposable NCV electrodes of size 3.5cm x 2.7cm. Which can be replaced with reusable metal electrodes so again the cost will minimize.

So the current study says the newly developed cervical nerve tension assessment screening tool gives quiet similar readings when compared with standard device in both healthy and unhealthy individuals with very significant p value as there is high degree positive correlation between both the devices. Physiotherapist can easily perform NCS with this newly developed NCS screening tool.

V. CONCLUSION

On the basis of this study, it was concluded that Cervical Nerve Tension Assessment Screening Tool among Subjects with Cervical Radiculopathy can be alternative to the existing NCS device to perform investigation like Nerve conduction velocity of affected nerves. The readings of cervical nerve tension assessment screening tool matches with the standard existing device of NCS.

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