INTRA RATER RELIABILITY OF SMARTPHONE APPLICATION ON ELBOW EXTENSION RANGE OF MOTION IN UPPERLIMB NEURODYNAMIC TEST 1 IN CERVICAL RADICULOPATHY

Arunpraveenraj D.[1]* and K. Jothi Prasanna*[2]

[1]Post Graduate Student, SRM College of Physiotherapy, SRM Institute of Science and Technology, Faculty of Medical and Health Sciences, SRM Nagar, Kattankulathur, Chengalpattu 603203, Tamil Nadu, India.
[2]Assistant Professor, SRM College of Physiotherapy, SRM Institute of Science and Technology, Faculty of Medical and Health Sciences, SRM Nagar, Kattankulathur, Chengalpattu 603203, Tamil Nadu, India.

*Corresponding Author: K. Jothi Prasanna
Assistant Professor, SRM College of Physiotherapy, SRM Institute of Science and Technology, Faculty of Medical and Health Sciences, SRM Nagar, Kattankulathur, Chengalpattu 603203, Tamil Nadu, India.

ABSTRACT

Backround: Although diagnosis of cervical radiculopathy remains largely oriented towards clinical aspect. In order to justify proper assessment and therapeutic interventions and prove its effectiveness, physiotherapist need to incorporate certain objective measures in the practice. Hence its necessary to find out whether the measurements are reliable. **Objective:** To Evaluate the Intra -rater reliability of smartphone application in the assessment of elbow extension range of motion at pain onset and maximum tolerable point during the upper limb neuro dynamic test1(ULNTT1) among subjects with cervical radiculopathy. Study Design: Descriptive Design. SAMPLE SIZE: 45 subjects. **STUDY SETTING:** Physiotherapy Out Patient Department, SRM Medical college and research Centre. Procedure: 45 subjects were included in this study based on inclusion and exclusion criteria. The Intra-rater reliability was tested in 45 subjects with unilateral cervical radiculopathy by a single assessor with 1day interval using I handy app. **Results:** The ULNTT1 measures between the day 1 and day 2 pain onset were 19.77 and 19.66 and the ULNTT 1 measures between day 1 and day 2 pain tolerable level were 21.7 and 22.73 respectively. The inter class correlation coefficient for the intra rater reliability is 0.000 compared coefficient is significant at 0. 000. Table 1: shows the 'r' value to be highly statistically significant there by showing high correlation between day 1 and day 2 pain onset and pain tolerable. Table 2: shows the 'r' value to be highly significant there by showing high correlation between day 1 pain tolerable and day 2 pain tolerable. **Conclusion:** This study estimates the reliability of a smart phone app in measuring the pain response of upper limb nerve tension test 1 in subjects with cervical radiculopathy and the data justifies the incorporation of this tool into clinical practice.

KEYWORDS: Reliability, Range of motion, I handy app, ULNTT1, Cervical radiculopathy.

INTRODUCTION

Cervical radiculopathy is a pain and sensory motor deficit syndrome that is generally caused by compression of cervical nerve roots occurring with an annual incidence rate of 63.5 to 07.3 for 100,000 for women and men respectively.[1]

It commonly occurs due to disc herniation, spinal degenerative changes presenting with sharp, achy, pins and needles and burning type around among the neck area, trapezius, shoulder, unilateral or bilateral arm or chest area.(Abbed & Coumans, 2007; Corey & Comeau,[2]

The location and pattern of symptoms will vary, depending on the involvement of nerve root level that brings changes in sensory and motor functions[3] cervical radiculopathy present with a broad variety of clinical symptoms ranging from pain to muscle weakness and diminished reflexes. Diagnostic accuracy place a main role in this condition as it forms the baseline for framing the interventions as the condition mainly follows a particular dermatomal pattern, keen evaluation focusing the nerve distribution is essential.[4]

People who are oriented to jobs such as heavy weight lifting drivers, software professionals and home makers are more prone to develop spondylitic changes with radiculopathy.

Degenerative changes in the cervical segments disc protrusions, nerve root involvement, and trauma are the

main cause for the symptoms. Radicular findings in the arm originate from the cervical nerve roots at some point between their origins as nerve rootlets from the spinal cord and their transition into peripheral nerves as they emerge from the neural foramen. Nerve root impingement, osteophytes, ligament atrophy are the cause for the stenosis and radiculopathy.[5] Compress the exiting nerve roots leads to spasm, obstruction of venous flow and leads to edema.

Canal compromise due to stenosis can cause various motor and sensory deficits which tends to create an inflammatory response. This response is believed to cause inflammatory signs such as pain, oedema whichin turn leads to the formation of scar and fibrotic tissues Chronic edema and fibrosis /scar in the course of the nerve root plays an important role in altering the pain threshold and increases the sensitivity of the nerve root.[5]

Many recent literatures supports various manipulation techniques and benefits of exercise therapy approach in improving the pain and fuctional outcomes in subjects with cervical radiculopathy.[6] Proper evaluation helps to determine the effective treatment for the dysfunction.[7]

Many Provocative tests which aids in the diagnosis of cervical radiculopathy which include the Spurling test, Valsalva manoeuvre, Neck compression and distraction, and Elveys upper limb tension test (ULNTT) ULNTT (sensitivity 72–83%, specificity 11–33 %).[8]

The reliability of upper limb neuro dynamic test 1 in cervical radiculopathy patients are clinically useful and reliable. In high mechanosensitive tissues, it is expected that is greater response (ie, hyper sensivity, hyperalgesia, more resistance to motion because of muscle spasm) occurs which stops elbow extension range of motion(EE-ROM) at an earlier phase during the test and determines its end. Even though various instruments such as inclinometers, goniometers are available in assessing the range of motion and outcomes of the procedures in clinical practice, most of them are time consuming, require high skills etc. Advance technological solutions such as usage of smart phone application have suggested to overcome these limitations. At present most smart phones have embedded motion sensors, which through software application allow real-time detection and quantification of linear and angular motion of the device in the 3 planes of orientation. A number of studies have shown that smartphone measurement provides, in general valid and reliable results for the evaluation of curvatures and movements of the spine and the orientation and range of motion of different segments and joints of the upper and lowerlimbs, furthermore, because they are easy to use, portable and frequently used by clinician for communication purpose, smartphone have the potential to assist these professional in clinical decision making and evaluation of interventions both inside and outside

the clinics without involving significant costs, however smartphone measurement properties have never both tested during neuro dynamic assessment.

The purpose of this study was therefore to estimate the intra-rater reliability of this application of a smart phone in the assessment of elbow extension range of motion at pain onset and maximal tolerable point during the ULNTT1.

PROCEDURE
Study design is Descriptive and study type is observational design including men and women Of 35-55 years using convenient sampling. Informed consent was obtained from each participant. The subjects were selected based on the inclusion criteria with Participants who have range of motion in upper limb joint which cannot prevent upper limb Neurodynamic testing and exclusion criteria such as musculoskeletal abnormalities in upper body quadrant, contra indication for physical therapy such as infection, tumor or fracture presence any cognitive problems, Central Nervous system Disorders. The procedure was clearly explained to the subjects.

The intra-rater reliability was tested in forty five symptomatic subjects by a single assessor at 24 hours interval.

Participants were asked to lie down supine with their lower limbs straight and they should be close to the border of examining table and upper limb in neutral position.

The participants head and neck were stabilized in maximum comfortable contralateral side flexion using 5-kg sand bag.

The measurements were taken twice on both sides by one examiner. The smart phone was coupled to participant forearm using a forearm band with a loop fastener strip to secure the smart phone during the procedure.

Initially the test (ULNTT1 is done on the unaffected limb or the asymptomatic side to demonstrate the participant as to how this test will be carried on further i.e. demonstrate the participant.

Further the test carried on the affected limb or the symptomatic side to notice the sensory responses and as they could feel any pain, they should report during the onset of pain and the maximum tolerable point.

The description of the onset of the pain and maximum tolerable point were defined as the time when there was onset of pain and the level of pain the participate was prepared to tolerate respectively.

The participants were instructed to inform the examiner when pain onset and the maximum tolerable point occurred during extension of the elbow.

Once the measurement was performed and recorded by I phone, the participants were asked to return to the starting position.
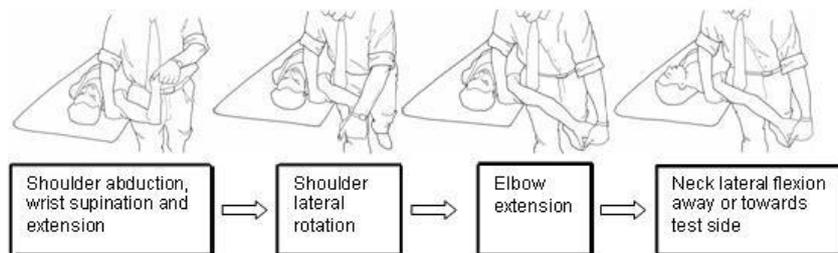
Next session was carried out after 24 -48 hours gap. The symptomatic side was tested to get the values of during onset of pain and the maximum tolerable point.

Each measurement was again obtained twice with I phone application. After this, the mean value of the two measurement were used for analysis.

OUTCOME MEASURE
A smartphone with built-in sensors that measure the

position and orientation of the device in the space (iPhone 5S, iOS 10.

ONSET OF PAIN

| Shoulder abduction, wrist supination and extension | ⇒ | Shoulder lateral rotation | ⇒ | Elbow extension | ⇒ | Neck lateral flexion away or towards test side |

MAXIMUM TOLERABLE PAIN

DISCUSSION
The primary goal of the study is to find the intra-rater reliability of smart phone application on elbow extension range of motion in subjects with cervical radiculopathy. There were 45 subjects included in the study, out of

which 26 were male and 19 were female.

Among the various special test that are done for cervical pathology, nerve tension tests are not commonly performed by the clinicians in practice because of its

complexity and most of the time the pain response and its descriptions from the patients goes unnoticed.

Keeping this in mind my study aims to escalate the application of this app through the smart phones which is easily accessed and applied with free of cost that can help the clinicians to make the evidence based diagnosis with appropriate values. The existing methods like goniometer, inclinometer are expensive and now- a -days as the smart phone supports many health care apps it is easy to use the tool which is readily available as everyone started using smart phones.

Brunilda agalliu, nicola baer et al(2015) have suggested that reliability of joint position can be achieved with traditional and smart phone based goniometric measurements.

Majid ghasemi, khodayar golabchi et al (2013) recommended the usage of ULTT for sceening purposes in patients with neck and arm pain to diagnose cervical radiculopathy.[11]

The ability to measure the reliability of ULNTT1 within same sessions and in different days is important, clinician can better monitor the response of rehabilitation when they are confident, that the changes are due to intervention and not a measurement error.

The factors along with the case of the position and the aspect of the measurement recording capability may have to contribute to the similar values obtained by examiner.

This technique is viable choice for clinician who have restriction of the available equipment, time setting and when multiple people are obtaining for diagnosis.

Like many other reseachers in this study also there are certain limitations. i.e Some subjects were not able to cooperate with ULNTT test procedure as there was severe pain and restrictions which makes them not cooperative for the study.

Similarly other researchers has shown good reliability when assessed in individual without any cervical pathology. This study reported to moderate to excellent intra- rater reliability for day1 and day 2 pain onset and pain tolerable values. Future studies should investigate the reliability to assess various nerve bias using other ULTT procedures.

DATA ANALYSIS
The intra rater test was analyzed with Pearson(p=0.01) correlation coefficient data was analyzed with Pearson (p=0.01) in SPSS version 17.

Table 1: This table shows r value to be highly statistically significant thereby showing a high correlation between Day 1 and Day 2 pain ons.

	MEAN DEVIATION	S.DEV	DEGREES OF FREEDOM	R VALUE	SIGNIFICANT P=0.005
DAY1 ONSET OF PAIN	21.7438	15.05997	44	0.901	0.000
DAY 2 ONSET OF PAIN	22.7336	15.09297		0.901	

Table 2: This table shows r value to be highly statistically significant thereby showing a corelation between day 1 and day 2 pain tolerable.

INTRA RATER	MEAN DEVIATION	S.DEV	DEGREES OF FREEDOM	r VALUE	SIGNIFICANT P=0.005
DAY1 ONSET OF PAIN	19.7720	13.76581	44	0.998	0.000
DAY 2 ONSET OF PAIN	19.6698	13.72450		0.901	
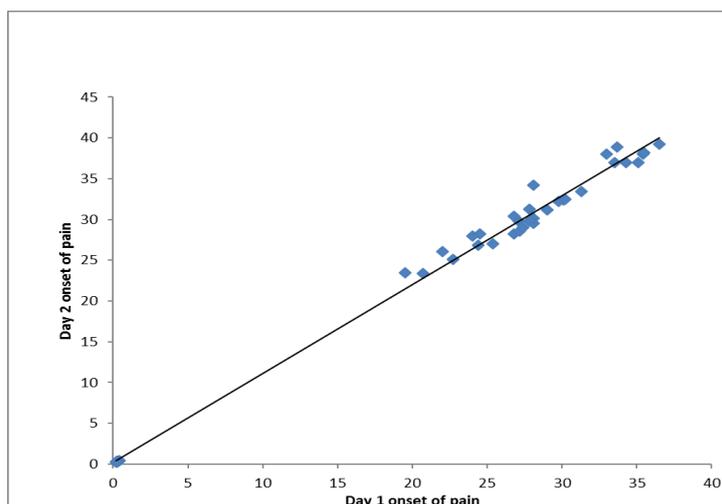
Graph 1: Coorelation Between Intra -Rater Day 1 and Day 2 Pain Onset1.
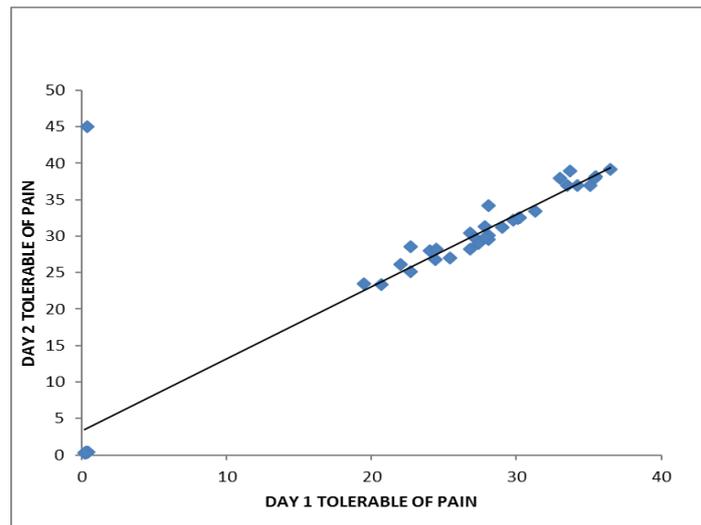
Graph 2: Correlation Between Intra-Rater Day 1 Tolerable And Day 2 Toler.

CONCLUSION

This study estimates the reliability of a smart phone app in measuring the pain response of upper limb nerve tension test 1 in subjects with cervical radiculopathy and the data justifies the incorporation of this tool into clinical practice.

CONFLICT OF INTEREST: NIL.

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