

Original article

Intra-rater and inter-rater reliability of cranio cervical flexion test in symptomatic subjects of neck pain using pressure biofeedback

V. Rajalaxmi¹, S. Kotteswari², R. Nithya Nisha³, Mohan Nallathambi⁴

Abstract

Objective: To investigate the intra – rater and inter – rater reliability of cranio cervical flexion test in symptomatic subjects. **Background of study:** Neck flexor muscles endurance was negatively correlated with cervical pain and dysfunction. Cranio cervical flexion test protocol has been advocated to train cranio cervical flexor muscle performance at present there is no consensus to the most effective method. The CCFT is a clinical test of neuromotor control of deep flexor of the cervical spine. **Methodology:** This was an observational study design with test-retest type and conducted in the ACS medical college and hospital. 50 samples were selected based on inclusion criteria. The CCFT was measured by one tester twice for intra rater reliability and two testers for inter-rater reliability were again tested after 24 Hours (Next day) by keeping time and environment optimal. In this CCFT, the activation pressure score and highest-pressure score was measured using Pressure Biofeedback unit. **Result:** The mean score for Activation Pressure by intra-rater tester one was found to be 2.24 (1.69) and 2.64 (1.48) in retest. The ICC intra-rater score for Highest pressure value by tester one was 23.92 (2.17) and 24.32 (1.99) in retest. The mean score for activation pressure by Inter – rater examiners was found to be 2.92(1.15) by examiner - 1 and 2.72(1.19) by examiner - 2. The ICC Inter – rater score for highest pressure value by examiner - 1 was 24.32(1.95) and 24.4(2.33) by examiner - 2. The ICC value of the study indicated high reliability of the activation pressure and highest-pressure value among the intra and inter-raters. **Conclusion:** The CCFT has high inter-rater and intra-rater reliabilities in symptomatic subjects.

Keywords: Reliability; Neck pain; CCFT; Pressure Biofeedback unit; VAS.

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Introduction:

Neck pain is a significant problem in modern society, with one-year prevalence values in world population varying from 16.7% to 75.1%¹ (Seema Kotwani, 2016). It may be related to severe pathology such as nerve

compression, prolapsed intervertebral disc, fracture. Neck pain has no specific and identifiable cause and is regarded as nonspecific neck pain¹

The primary function of cervical spine is to orient head against the opposing forces of gravity permitting

1. V. Rajalaxmi, Professor, Faculty of Physiotherapy, Dr. M.G.R. Educational & Research Institute University, Velappanchavadi, Chennai - 600 077, Tamil Nadu, India.
2. S. Kotteswari, Physiotherapist, ³Assistant Professor, Faculty of Physiotherapy, Dr. M.G.R. Educational & Research Institute University, Velappanchavadi, Chennai - 600 077, Tamil Nadu, India.
3. R. Nithya Nisha, Assistant Professor, Faculty of Physiotherapy, Dr. M.G.R. Educational & Research Institute University, Velappanchavadi, Chennai - 600 077, Tamil Nadu, India
4. Mohan Nallathambi, Senior Physical Therapy Practitioner, Al Farwaniya Hospital, Ministry Of Health, P.O.Box 13373, Farwaniya 81004 road 602, Hamoud Al-Jaber Al-Sabah road, Sabah Al-Naser, Kuwait.

Correspondence: V. RAJALAXMI, Vice Principal, Faculty of Physiotherapy, Dr. M.G.R. Educational & Research Institute University, Velappanchavadi, Chennai - 600 077, Tamil Nadu, India.

Email: rajalaxmiphysio@gmail.com

multi-directional movement. To complete this task, the cervical spine must be mechanically stable, both in static as well as dynamic postures. In neutral upright postures, resistance to cervical spine motion by passive structures is minimal². Functionally, motion at the specialized cranio cervical (CC) articulations can occur independently of the remainder of the cervical spine, and it is particularly important for fine control of head orientation serving the visual, vestibular, and proprioceptive systems³

The craniocervical flexion test (CCFT) is a clinical test for neuromotor control of the deep flexors of the cervical spine. It was originally developed in response to increased interest in the functional roles of muscles particularly in spinal segments stabilization, and the clinical need for more directed and specific therapeutic exercises for patients with neck pain disorders⁴. The CCFT was also used in research about the performance of the cranio cervical flexion test in patients with chronic tension type headache⁵. Craniocervical flexion is the principle action of the deep cervical flexor muscles (longus capitus, longus colli (superior portion), and rectus capitis(anterior) that structurally support cervical motion segments⁶. Andre-Deshays C(1991) reported that the longus colli and dorsal neck muscle from a sleeve that stabilizes the cervical spine in all positions against the effects of gravity. It has been theorized that when muscle performance is impaired, the balance between the stabilizers on the posterior aspect of the neck and the DCFs will be disrupted, resulting in loss of proper alignment and posture, which is then likely to contribute to cervical impairment Therefore DCF training is recommended for increasing the endurance of these postural muscles, leading to improvement in Neck pain⁷.

Previous studies have demonstrated a loss of strength and endurance in the neck flexor synergy in patients with neck pain. Because of the functional differentiation in the neck flexors, the craniocervical flexion test was developed as an indirect measure for the clinical evaluation of the deep cervical flexor muscles and the longus capitus and colli muscles⁸. It is important to be aware that the activity of superficial muscles may mask the impaired performance of the DCF. The CCFT developed by Jull is an easy non – invasive, low load clinical test used to assess as well as retrain the DCF⁹.

This test consists of precise and controlled performance and maintenance of positions of craniocervical flexion. There is no head lift

component which engages the more superficial muscles sternocleidomastoid and anterior scalene muscles. In this method, an air field pressure sensor is placed between the testing surface and upper neck to monitor the flattening of cervical lordosis along with the contraction of deep cervical flexors. The test was initially used in the clinical setting and observations of the inability of patients with neck pain to perform the test, and the positive clinical response to training the action¹⁰

Moreover, this outcome measure is not use in the Indian population and it has also not been used till date for evaluating the inter - rater reliability in any of the population. This point is unique to this study. If reliability of the CCFT is good, it can be used as an effective assessment tool for assessing DCF endurance¹¹

In a study that investigated a validity of PBU instrument has concluded that the PBU provides valid measures, but their findings are not conclusive due to the small sample size (n = 15). In a recent low risk of bias study, it was found that the reproducibility of PBU was observed as ICCs of 0.74 and 0.76 for intra- and inter-examiner reproducibility¹² Arumugam et al (2013) evaluated the inter-rater reliability of the test. But scoring system used and measured only the holding capacity and not the endurance of the DCF. The ICC for inter-rater reliability is 0.907(p<0.05) whereas for intra-rater reliability, it is 0.986(p<0.050). The ICC is interpreted by using the work of Portney and Watkins¹³.

Methodology:

Once the study is approved by the institutional review board ,50 samples were selected by convenient sampling out of 65 volunteers based on the inclusion criteria and excluded those with Cervical spondylosis, Cervical Fracture and Cervical radiculopathy. The study was conducted in the OPD of physiotherapy and took 3 months to complete the study (January 2019 to March 2019). The subjects were fully explained about the study and the test they have to undergo and the consent form which is duly signed by the samples and physiotherapist in acceptance to participate in the study. Basic demographic details like Name, Age, Sex were collected assuring confidentiality of the same.

INTRA – RATER AND INTER - RATER RELIABILITY PROCEDURE:

One tester performed the test on each subject twice for intra-rater reliability and two testers performed

the test on each subject for the inter-rater reliability. For the intra-rater test the subjects were allowed to perform CCFT, meanwhile the activation pressure and highest-pressure value is noted. Moreover, at the end of the test, the subjects were instructed to rest for 15-20 minutes. During this time, the subject was instructed to remain supine and turn his or her neck from side to side through a pain-free range of motion at least 3 times without raising the head from the table. The therapists simultaneously did the same procedure for the inter-rater reliability. Furthermore, for the inter-rater test, All the subjects were again tested after 24 hours (next day) by keeping the time and environment optimal. Data thus obtained were used to calculate intra-rater reliability of the CCFT. The same testing procedure and equipment was followed for the all the subjects.

CCFT METHODS: Subjects were first taught how to perform the CCFT by viewing a video to standardize the instructions and the content of information about the test. Practice session was done to ensure that the subject properly understood the required movement once the subject learnt how to perform the craniocervical flexion action; a brief rest period was given. The subject was positioned in two crook or supine lying Position. The cervical spine was supported in a neutral position, which was determined visually by maintaining or horizontal plane between the forehead and chin. Verbal commands like tuck your chin or hold your head up. Additionally, a layer of towel was used under the

head, if the subject needs it. The Pressure Biofeedback unit was placed between the plinth and the posterior aspect of the neck just below the occiput and inflated to a baseline of 20mmHg. The therapist observed and corrected any substitution movements to ensure that all subjects could perform the test correctly. Each subject was remained to relax the neck musculature and to concentrate on performing a gentle, nodding head movement. Each subject was instructed to perform the neck craniocervical flexion movement at 5 different pressure levels (22, 24, 26,28,30mmHg) and to hold each level of 10 seconds. A 30 second rest period was provided between each level. The testing procedure ended when the subjects could not hold a specific pressure level of 10 seconds or the maximum level of 30mmHg was achieved. Measurement was recorded to the nearest sound.

With the CCFT two items were measured in two phases, respectively Activation Pressure Value (Apv), Highest Pressure Value (Hpv)¹⁴

DATA ANALYSIS

Data Analysis was done using the SPSS software (v.20.0). An intra-class correlation coefficient for intra and inter-rater reliability was used for the study. Intra-class correlation coefficient (ICC) for both the Intra and Inter-rater reliabilities was done with the 95% CIs. Bland-Altman limits of agreement analysis for assessing the agreement between two testers scores were by the tester one twice. SEM was used to calculate the variability in measurements of same tester and measurement taken by 2 testers.

Table-1: Intra-class correlation coefficient for intra-rater reliability of test – retest values in ccft.

VARIABLES	TEST VALUE	RETEST VALUE	CRONBACH'S ALPHA	r-VALUE
	MEAN±SD	MEAN±SD		
ACTIVATION PRESSURE VALUE	2.24±1.69	2.64±1.48	0.913	0.816***
HIGHEST PRESSURE VALUE	23.92±2.17	24.32±1.99	0.961	0.910***

***correlation significance-p≤0.001

Table-2: Intra-class correlation coefficient for inter-rater reliability of the ccft scores

VARIABLES	EXAMINER 1	EXAMINER 2	CRONBACH'S ALPHA	r-VALUE
	MEAN±SD	MEAN±SD		
Activation pressure value	2.92±1.15	2.72±1.19	0.857	0.743***
Highest pressure value	24.32±1.95	24.4±2.33	0.920	0.853***

***correlation significance-p≤0.001

Table – 3 Intra-class correlation coefficient for inter and intra -rater reliability of the ccft.

VARIABLES	TEST VALUE	RETEST VALUE	EXAMINER 1	EXAMINER 2	CRONBACH'S ALPHA	r-VALUE
	MEAN±SD	MEAN±SD	MEAN±SD	MEAN±SD		
Activation pressure value	2.24±1.69	2.64±1.48	2.92±1.15	2.72±1.19	0.925	0.728***
Highest pressure value	23.92±2.17	24.32±1.99	24.32±1.95	24.4±2.33	0.971	0.884***

***correlation significance- $p \leq 0.001$

Ethical Considerations: The manuscript is approved by the Institutional Review board of faculty of Physiotherapy (IRB REF NO: IV D- 023/ PHYSIO/ IRB/2018-2019).

Results:

The mean value of age is 31.16 (3.22) and the percentage of male and female is 66% and 34%. The mean score for Activation Pressure by intra-rater tester one was found to be 2.24 (1.69) and 2.64 (1.48) in retest. The ICC intra-rater score for Highest pressure value by tester one was 23.92 (2.17) and 24.32 (1.99) in retest. The mean score for activation pressure by Inter – rater examiners was found to be 2.92(1.15) by examiner – 1 and 2.72(1.19) by examiner – 2. The ICC Inter – rater score for highest pressure value by examiner – 1 was 24.32(1.95) and 24.4(2.33) by examiner - 2.

The Bland-Altman chart is a scatter plot with the mean differences of the test and retest values in the vertical axis and average of two measurements on the horizontal axis. The lower and upper control limits is determined by plus and minus of 1.96 sigma from the SD of the measurement differences error. It showed a reasonable agreement between the testers.

Discussion:

In the present study patient between the age group of 25-35 years old. The study was conducted to investigate the Intra-rater reliability and inter-rater reliability of cranio cervical flexion test in symptomatic subjects. In our study 50 participants were conveniently selected. The Pressure Biofeedback unit which was placed behind the neck monitored the flattening of cervical spine as the deep neck flexors were activated. This test was developed because of interest in functional role of muscles particularly in relation to activate spinal segmental stabilization and the clinical need of more specific exercises for patients with neck pain¹⁵.

For developing the CCFT, the DCFs primary anatomical action, Flexion of the head on stable

cervical spine, is utilized shows high intra –rater and inter-rater reliabilities four studies evaluating intra-rater reliability and one study evaluating Inter-rater reliability of the of the CCFT are available in the literature ARUMUGAM et al., evaluated the intra-rater reliability of the test¹⁶. Future studies will need to investigate the underlying physiological mechanism associated with improvements in CCF muscle performance therapeutic exercise programs. Gains in Isometric strength following rehabilitation have been co-related with increases in cross-sectional area of neck muscles¹⁷.

Shaun O' Leary, et al(2007) found that impairments in CCF muscle performance appears to be a feature in some chronic neck disorders. The result of this study suggest that isometric CCF muscle performance can be retrained with either a specific CFEx protocol or a conventional CFEx [head tilt] program in patients with a mild level of reported Neck pain and disability. Clinicians should keep these options in mind when prescribing exercise for a patient with mild neck pain who demonstrates CCF muscle impairment, but should apply caution to extrapolating the findings of this study to patients with higher levels of reported neck pain and disability^{18,19}.

Although acceptable test reliability was found for subjects without neck pain, such a finding is not of significant clinical utility for therapists who want to use the test in the management of patients with neck pain^{20,21}. Our intention for assessment of inter-rater reliability was due to the desire to asses this particular measurement properly and the associated clinical implication for therapists with neck pain. Future studies of this neck flexor muscle endurance test, we believe, should assess intra-rater reliability for subjects with neck pain and perhaps attempt to further objectify and classify those subjects with neck pain upon admission to a study using a measurement tool, such as the Neck Disability Index^{22,23}. However the CCFT has widely been used by physical therapists to determine alterations in motor control of the craniocervical flexor muscles in

people with cervical disorders such as Neck pain²⁴. One study revealed there is a decrease in neck muscle endurance and neuromotor control among students²⁵. This systematic review maximum studies showed that there was some improvement in neck functional abilities and reduction in neck pain in the endurance training group²⁶. Motor control exercise has high impact on neck pain and led to marked relief in pain intensity, disability and in improving the endurance of the neck muscle²⁷. Outcome has been proposed that Mulligan Mobilization with Movement (MWM) with SNAG to the Group A has given huge difference and more noteworthy change when compared with Group B²⁸. The cost-effectiveness is an important factor in low-income countries where economic aspects of health care are highly considered. These

advantages of physiotherapy should be considered by the clinicians, policymakers, patients, and included in the clinical guidelines²⁹. Augmenting conventional physiotherapy with lumbar stabilisation exercises achieved better reduction in disability than conventional therapy alone in patients with NSCLBP³⁰.

Conclusion:

This study shows that CCFT is a good method to assess DCF endurance. Result of the study support the use of CCFT as an objective outcome measure in evaluating DCF endurance for symptomatic subjects.

Conflict of Interest: ‘Conflicts of interest: none’

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