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INTER AND INTRA-RATER RELIABILITY OF THE CRANIOCERVICAL FLEXION TEST BY USING MODIFIED SPHYGMOMANOMETER AS A PRESSURE BIO-FEEDBACK

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ABSTRACT

Background and Objective: The Cranio-Cervical Flexion Test (CCFT) is a reliable clinical and research test to measure the endurance of the Deep Cranio-Cervical Flexors (DCCF) muscles via Activation Score (AS) and Performance Index (PI) by using Chattanooga Pressure Biofeedback unit (CPBU). In India, we use modified sphygmomanometer instead of CPBU for this test, but the data on reliability of the instrument is scarce. So present study was carried out to check inter and intra-rater reliability of the CCFT by using modified sphygmomanometer.

Methods: 50 subjects were selected from the age group of 17 to 22 years. For inter-rater reliability the AS and PI were measured on each subject by two different experienced Physiotherapists and For intra-rater reliability the same was measured on two occasions with 7 days gape by the same therapist. ICC-Pearson was calculated to check inter and intra-rater reliability. **Results:** For AS and PI good inter-rater reliability determined by the ICC= 0.709 and 0.752 respectively and excellent intra-rater reliability determined by the ICC=0.820 and 0.885 respectively. **Conclusion:** The CCFT by using modified sphygmomanometer showed good inter-rater and excellent intra-rater reliability.

Keywords: Cranio-Cervical Flexion Test, Modified Sphygmomanometer, Deep Cranio-Cervical Flexors, Reliability

INTRODUCTION

The Cranio-Cervical Flexion Test (CCFT) is a clinical test of the anatomical action of the deep cervical flexor muscles, the longus capitis, and colli.¹ It has evolved over 17 years as both a clinical and research tool and was devised in response to research indicating the importance of the Deep Cranio-Cervical Flexors (DCCF) in support of the cervical lordosis and motion segments and clinical observations of their impairment with neck pain.¹⁻⁵

CCFT is a low-load test performed in the supine position with the patient guided to each stage by feedback from a pressure sensor placed behind the neck.¹ The features assessed in this test are the Activation Score (pressure that subject can achieve and hold for 10 seconds) and the Performance Index (calculated by multiplying the activation score by the number of successful repetitions) of the DCCF during the performance of five progressive stages of increasing cranio-cervical flexion range of motion.^{1,6}

The CCFT using Chattanooga Pressure Biofeedback unit (CPBU) is considered as the most reliable tool as proven by both clinical and EMG studies compared to

other tests for the measurement of DCCF muscle endurance in subjects with and without neck pain.^{1,7,8,9} In previous Indian studies, modified sphygmomanometer has been used as a pressure sensor instead of CPBU for the measurement of DCCF muscle endurance.^{10,11,12,13} The modified Sphygmomanometer has been found to be a reliable instrument for the measurement of the DCCF isometric muscle strength in subjects with and without neck pain,¹⁴ but the data on reliability of the instrument for the measurement of DCCF muscle endurance is scarce which signifies the need of the present study. The main aim of this study is to check inter and intra-rater reliability of the CCFT by using modified sphygmomanometer as a pressure biofeedback to measure DCCF muscle endurance.

MATERIAL AND METHODS

This study was a Co-relational study, conducted at the SPB Physiotherapy College, Surat.

The co-relational procedure was ethically revised and approved by the Research and Ethical committee of SPB Physiotherapy College, Surat

Sample Population and Sample Size: 50 asymptomatic subjects; male (n=20) and female (n=30) were selected from the age group of 17 to 22 (Mean age 19.86) years. The study population covers the students of SPB Physiotherapy College, Surat and were recruited according to the inclusion and exclusion criteria mentioned below

Inclusion Criteria:

1. Subjects with no history of neck pain and
2. Subjects within the age group of 17 to 22 years.

Exclusion Criteria:

1. Subjects with any history of neck pain,
2. Subjects with history of any surgery in and around cervical spine,
3. Subjects performing regular exercises of the neck muscles

After meeting suitable criteria, the written informed consent was obtained from each subject after explaining the details of CCFT to be conducted on them. Primary assessment for demographic characteristics and outcome measures was taken. The Same procedure for CCFT was used as described by Jull G 2000¹, but in present study modified sphygmomanometer has been used instead of CPBU in original procedure.

(a) **Outcome Measure** : Activation Score (AS) and Performance Index (PI)

(b) **Data Collection:** For inter-rater reliability the AS and PI were measured on each subject by two different experienced Physiotherapists, rater-1 and rater-2 (Figure-1 and Figure-2).

For intra-rater reliability the same was measured on two occasions with 7 days gap by the same therapist i.e. rater-2 (Figure-1).



Figure-1: Measurement of AS and PI A) by rater-1 on day1, B) by rater-2 on day1

(c) **Data Analysis:** Two-tailed Intra-class Correlation Coefficient (ICC-Pearson) was calculated by SPSS13.0 version to check inter and intra-rater reliability at 0.01 level of significance for AS and PI separately.

RESULTS

There were no drop outs throughout the study, all 50 subjects were examined by both the therapist timely as per the methodology.

Mean age of the subjects was 19.86 ± 1.25 years. Mean weight was 54.98 ± 12.34 kg and mean height was 163.78 ± 9.77 cm. Mean BMI was 20.38 ± 3.49 .

Mean, Standard deviation, standard error of mean and confidence interval at 99% confidence level for activation score and performance index were as per tabulated in table-1

ICC for activation score and performance index measured by two different therapists were 0.71 and 0.75 respectively which shows good inter-rater reliability. (Table-2) ICC for activation score and performance index measured by same therapist at 7 days gap were 0.82 and 0.89 respectively which shows excellent intra-rater reliability. (Table-2)

Table: 1 – Mean \pm SD, SEM and CI values for Activation Score and Performance Index

DCCF Endurance		Activation Score			Performance Index		
		Mean \pm SD	SEM	CI	Mean \pm SD	SEM	CI
Rater 1		8.32 \pm 1.86	0.26	7.65-8.99	65.68 \pm 17.22	2.44	59.38-71.98
Rater 2	Time 1	8.44 \pm 1.86	0.26	7.77-9.11	58 \pm 18.74	2.65	51.42-64.84
	Time 2	8.24 \pm 1.74	0.25	7.59-8.89	59.88 \pm 18.45	2.61	53.51-66.61

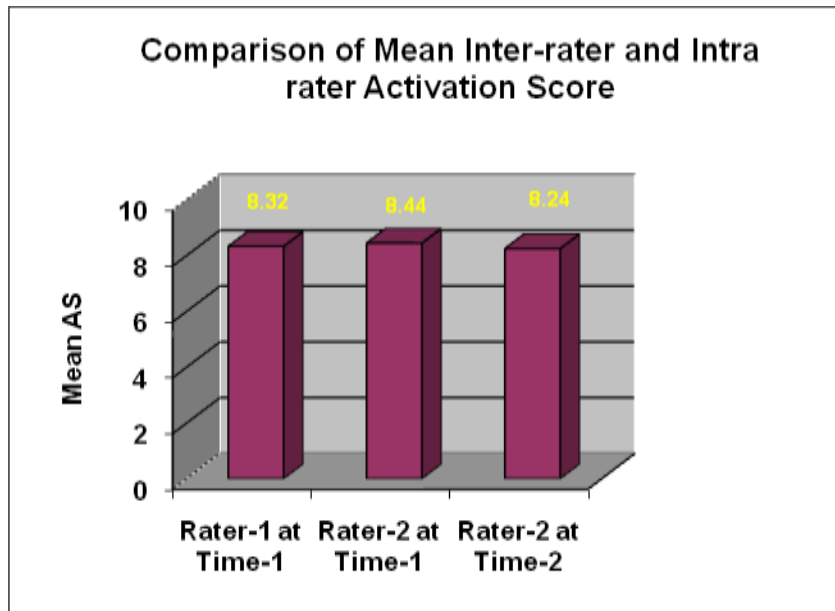
SD = Standard Deviation, SEM = Standard Error of Mean,
CI = Confidence Interval at 99% confidence level

Table: 2 – ICC values for Activation Score and Performance index

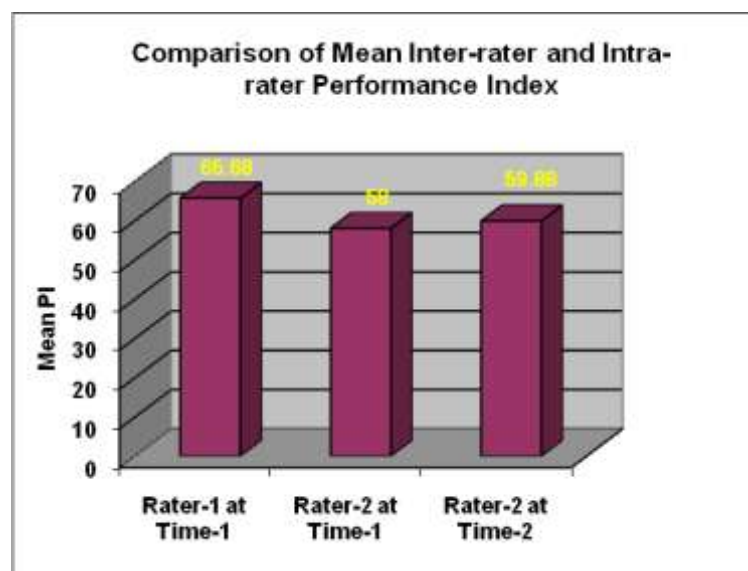
Reliability		ICC (Intraclass Correlation Coefficient)
Inter-rater	Activation Score	0.71
	Performance Index	0.75
Intra-rater	Activation Score	0.82
	Performance Index	0.89

ICC is calculated at 0.01 level of significance with 99% confidence interval.

Graph-1 Comparison of Mean Inter-rater and Intra-rater Activation Score



Graph-2 Comparison of Mean Intra-rater A) Activation Score and B) Performance Index measured at two different times



DISCUSSION

As a result of present study we found good inter-rater and excellent intra-rater reliability determined by ICC (Table - 1 and Table - 2). For quantitative measurements, ICC is the principal tool with Intra-class correlation 0.93 and confidence limits 0.88 – 0.96.¹⁵ The criteria for reliability have been defined as ICC: 0-0.2 = poor, 0.21-0.4 = fair, 0.41-0.6 = moderate, 0.61-0.8 = good and 0.81-1 = excellent.^{16,17}

These findings are matched with the findings [ICC(1,1)=0.81 and 0.93 for AS and PI] of study carried out by Jull G et al, 1999 using CPBU on asymptomatic subjects with age group (30±10) and sample size (n=50) similar to our study¹⁶ and also with the findings [ICC(1,1)=0.84 and 0.90 for AS and PI] of study carried out by Marta et al, 2007 with smaller sample size (n=10)⁶. However, findings of

our study differ from the findings of studies carried out by James G et al, 2010 [ICC(1,1)=0.98, SEM=8.94 for PI]⁷ and Sue Hudswell et al, 2005 [ICC(1,1)=0.78 for AS and PI, ICC(2,1)=0.57 and 0.54 for AS and PI]⁹. The clarification of difference in these findings can be attributed to smaller sample size (n=19) and large SEM (8.94) in the former study and to the selected sample population (which included patient with neck pain) in the later study. (Table-3)

Hence, modified sphygmomanometer can be used as a clinical and research tool as a pressure biofeedback instead of CPBU in CCFT as it shows good inter-rater and excellent intra-rater reliability. Cost effectiveness and easy availability of modified sphygmomanometer also accounts for its preference instead of CPBU for Indian therapists.

Table: 3 - Comparison of ICC findings of present study with the previous studies carried out by using Chattanooga pressure biofeedback unit

Studies		AS	PI	Sample size	Sample Population	Age Group
Our Findings	Inter-rater	0.71	0.75	50	Asymptomatic	19.86±1.25
	Intra-rater	0.82	0.89			
Jull G et al, 1999 ¹⁶	Intra-rater	0.81	0.93	50	Asymptomatic	30±10
Marta et al, 2007 ⁶	Intra-rater	0.84	0.90	10	Asymptomatic	39±6
James G et al, 2010 ⁷	Intra-rater	----	0.98 (SEM=8.94)	19	Asymptomatic	24.9
Sue Hudswell et al, 2005 ⁹	Inter-rater	0.57	0.54	40	Symptomatic	42.6±12
	Intra-rater	0.78	0.78			

Future Implications:

1. This study can be explored for all age groups; middle-aged and elderly.
2. Future studies can be carried out with large sample size.
3. Additional research on the same topic can be done which includes symptomatic patients with different cervicogenic disorders.

CONCLUSION

The Cranio-Cervical Flexion Test by using modified sphygmomanometer showed good inter-rater and excellent intra-rater reliability. So that we proved that the modified sphygmomanometer can be used as a pressure bio-feedback instead of Chattanooga Pressure Bio-Feedback in Cranio-Cervical Flexion Test as it is cost effective and easily available for all Physiotherapist.

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