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Original Research Article

Measuring the Strength and Endurance Capacity of Deep Cervical Flexor Muscles in Subjects With and Without Neck Pain - A Comparative Study

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ABSTRACT

Aim: This study was designed to compare the strength and endurance capacity of Deep Cervical Flexors in subjects with and without neck pain.

Method: Group A consisted of 30 subjects with neck pain and Group B consisted of 30 subjects without neck pain. Pressure biofeedback unit was used to assess the strength and endurance of the cervical flexors. Strength of the cervical flexors was measured as the maximum pressure at which the patient was able to hold steady for 10 seconds; and muscle endurance capacity was measured by the number of times the subject was able to hold up to 10-seconds at the maximum pressure.

Results: The t value for strength is t= -1.38 and p= 0.177 which shows no significant difference between both the groups and the t value for endurance capacity is t= -2.55 and p=0.016 which shows significant difference between both the groups.

Conclusion: The results of this study demonstrated that subjects with neck pain and without neck pain both shows good strength but the subjects with neck pain had a poor endurance capacity when compared to subjects without neck pain.

Key Words: Cervical muscles, Strength, Endurance, Neck pain, Pressure biofeedback unit.

INTRODUCTION

Neck pain is a common musculoskeletal disorder. Most episodes of neck pain are of unknown origin, usually referred to as nonspecific or idiopathic neck pain. [1] Occasionally neck pain may be related to a severe pathology such as nerve compression, a prolapsed intervertebral disc, or a fracture. [1]

Neck pain is a major source of disability and common global problem. The functional task of the cervical spine is to control head movements in relation to the rest of the body. It affects 30–50% of the general population annually. At any point in time, the prevalence of Neck pain is about 12% for the adult female population and 9% for the adult male population. Approximately 45% of the working population will have one attack of a stiff neck. [2]

Bad posture of neck with respect to chest is one of the commonest causes of chronic neck pain. This is common to the job related situations where the neck is kept in a flex position for long periods of time. Decreased strength in the neck muscles has been thought to be associated with chronic neck pain, because as researchers have pinpointed the neck flexor muscles as a site of weakness. [2] Studies have demonstrated a reduction in isometric endurance of the deep cervical flexor muscles in patients with neck pain. [1, 4]

The craniocervical flexion test (CCFT) is a low load test used to assess an

individual's ability to slowly perform and hold a precise upper cervical flexion action without flexion of the mid and lower cervical spine. [5] It is based on the anatomical interrelated action of the deep muscles (the longus colli and capitis) to support and stabilize the cervical spine as well as produce a flattening of the normal cervical spine lordosis. [1] The CCFT comprised a precise and controlled performance and maintenance of positions of craniocervical flexion in a supine position. [4] There are fewer studies, especially using a clinically applicable test, on quantifying cervical flexors muscular performance in subjects with neck pain.

Gwendolen A. Jull et al. in 2008; did a clinical assessment of the deep cervical flexor muscles by using the craniocervical flexion test and concluded that patients with neck pain disorders, compared to controls, have an altered neuromotor control strategy during craniocervical flexion characterized by reduced activity in the deep cervical flexors and increased activity in the superficial flexors usually accompanied by altered movement strategies and they display reduced isometric endurance of the deep cervical flexor muscles. [4]

Thomas Tai Wing Chiu et al. in 2005;conducted a study to compare the performance of the deep cervical flexor muscles on the CCFT in 20 individuals with neck pain and 20 individuals without neck pain and concluded that the patients with chronic neck pain had a poorer ability to perform the CCFT when compared with asymptomatic subjects. [1]

Sue Hudswell et al. in 2005; conducted a study to indirectly measure the strength of the deep cervical flexor muscles by using the CCFT with pressure biofeedback in 40 subjects and concluded that there was a 'good' inter-rater reliability and 'excellent' intra-rater reliability when using the CCFT. [6]

Jull G et al. in 1999; did a study to test the frequency of abnormal responses to passive stretching and abnormal muscle contraction in 15 subjects with cervical headache and 15 controls. And test of crania-cervical flexion was used to assess the contraction of the deep neck flexors. It was concluded that deep neck flexor muscle contraction was significantly inferior in the cervical headache group. [5]

Grimmer K in 1994; did a study for measuring the endurance capacity of the cervical short flexor muscle group with use of an exercise protocol described by Trott (1988), and it was concluded that the measurements of cervical short flexor endurance were reproducible over a one month interval and there was a systematic improvement in mean endurance capacity for both women and men. [7]

Strength of deep cervical flexors is defined as the maximum pressure at which the patient is able to hold steady for 10 seconds by maximum contractile activity of the muscles and endurance is the number of times that the subject is able to hold up to 10-seconds at the maximum pressure that is achieved.

Need of the study was to assess the strength and endurance of cervical flexors in subjects with and without neck pain by using a method which is quick and easy to administer in clinical settings. This method can be used as a part of assessment in day to day practice as it provides feedback and helps us to set the treatment goals.

The aim of this study was to measure and compare the strength and endurance capacity of deep cervical flexor muscles in subjects with and without neck pain by using the pressure biofeedback unit.

MATERIALS AND METHODS

Study design: Observational; cross-sectional study

The study consisted of 2 groups i.e. group A subjects with neck pain and group B subjects without neck pain. 60 subjects were enrolled for the study from the outpatient department of Government Physiotherapy College, Jamnagar, with 30 subjects in each group. Subjects were randomly selected from neck pain population and asymptomatic population.

Every alternate subject was further divided into 2 groups respectively. Age group of subjects was 25-55 years.

Sample size was decided based on the previous study. Blinding was done in the study. Before testing subjects were screened for eligibility criteria and informed consent was obtained from them.

Inclusion criteria: Both male and female subjects with and without neck pain between age group of 25 to 55 years and who were willing to participate in the study were taken. The subjects with history of trauma or surgery to the cervical spine, .neurological deficit, cervical myelopathy, or psychological problems and subjects who had participated in any form of specific strengthening of the neck and upper extremities musculature in the past 6 months were excluded.

Familiarization was done to the subjects by demonstrating the technique. Demonstration was done by making subject lie down in supine position on the plinth. Then the pressure biofeedback unit was placed under the suboccipital region and inflated to 20mmHg pressure. Then the subject was asked to do the nodding movement of head and see the pressure rise by visual biofeedback. After that the subject was asked to hold at the maximum pressure achieved for 10 seconds and then the number of repetitions that the subject was able to hold for 10 seconds was counted.

Materials and apparatus used:

- Consent form
- Hard plinth
- Pressure biofeedback unit (Chattanooga)
- Stop watch
- Pen

PROCEDURE

The subject was made to lie down in supine position on a hard plinth. Pressure biofeedback unit was placed under the suboccipital region and the pressure cuff was inflated to a pressure of 20 mmHg in order to fill the space of the cervical lordosis. Subject was asked to perform a gentle head-nodding action of craniocervical flexion (indicating yes). Maximum pressure increase above the baseline upto 10 mmHg was achieved and held for 10 seconds defining it as strength of deep cervical flexors. The final pressure was the one at which the subject was able to hold steady. For assessing endurance, final pressure which was achieved was multiplied by the number of repetitions performed by the subject successfully with 10 seconds hold at that pressure. Rest period of 10 seconds was allowed between the holds. Trick movements were avoided. Subjects were advised to discontinue the test if pain was experienced.

Statistical Analysis

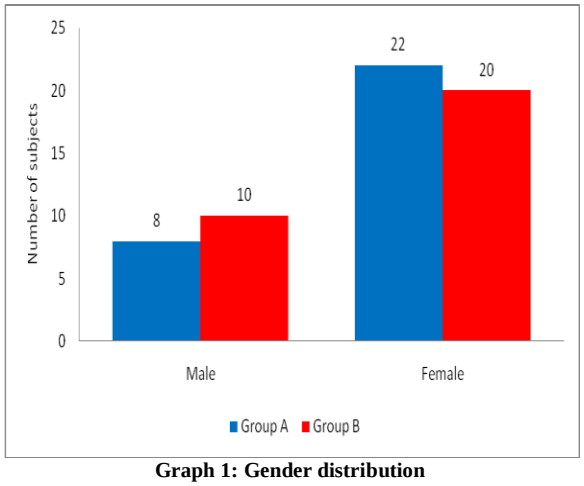
All analysis was carried out in SPSS windows Version 17.0. An alpha-level of 0.05 was used to determine statistical significance. Paired t-test was used to detect any difference in strength and endurance capacity between group A and group B.

RESULTS

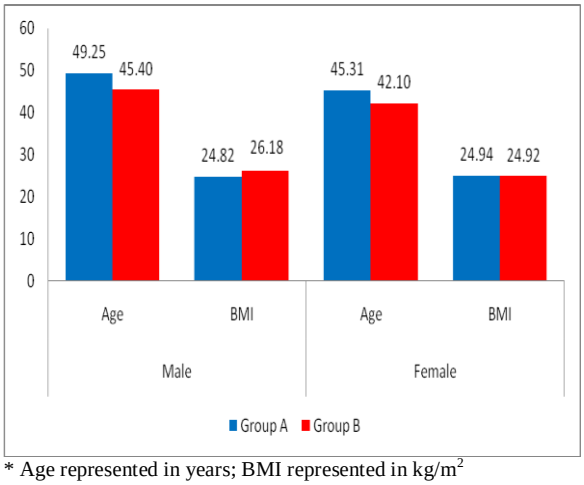
Table 1: Demographic characteristics of all subjects

Group	N	Gender		Age(yrs)	Height (meters)	Weight (kg)	Body Mass Index(kg/m^2)
Group A	30	Male	8	46.36 (9.34)	1.61 (0.08)	65.93 (11.62)	24.91 (3.43)
		Female	22				
Group B	30	Male	10	43.2 (9.67)	1.63 (0.07)	67.86 (13.62)	25.34 (5.09)
		Female	20				

All data are expressed as Mean (SD), N= number of subjects



Graph 1: Gender distribution



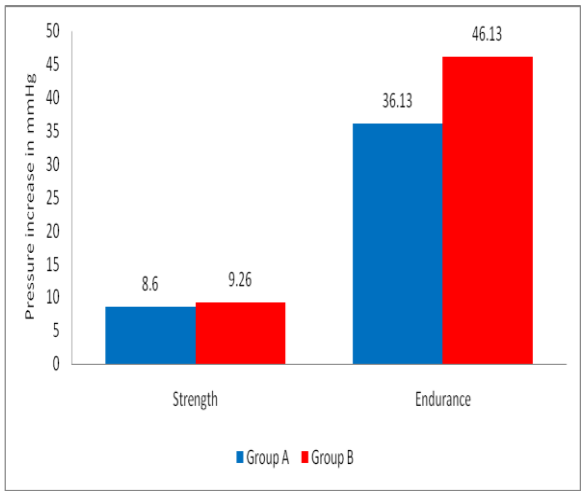
* Age represented in years; BMI represented in kg/m^2

Graph 2: Mean age and BMI of subjects

Table 2: Comparison of Strength and Endurance capacity between Group A and B

Outcome Measures	Group	Mean (SD)	Median	t-value	p-value	Result
Strength (mmHg)	A	8.60 (1.97)	10.00	-1.38	0.177	Not significant
	B	9.26 (1.33)	10.00			
Endurance capacity(Number of repetitions at highest pressure)	A	36.13(14.86)	32.00	-2.55	0.016	Significant
	B	46.13(10.63)	40.00			

As shown in table 2, there is no significant difference in strength between Group A and Group B at level of significance p=0.178. And there is significant difference in endurance capacity between Group A and Group B at level of significance p=0.016.



Graph 3: Mean strength and endurance capacity of Group A and B

DISCUSSION

In the present study total 60 subjects were taken and they were divided into 2 groups, A (symptomatic) group and B (asymptomatic) group. Strength and endurance capacity of deep cervical flexor muscles was assessed with by using pressure biofeedback unit. In the present study we used pressure biofeedback unit to perform craniocervical flexion test instead of electromyography this is because the pressure biofeedback unit is easy to administer and it is more feasible and cost-effective to use it in clinical settings.

The results of the present study shows mean strength for group A is 8.60 mmHg and group B is 9.26 mmHg which suggests strength to be less in group A compared to group B. Mean endurance capacity is 36.13 mmHg in group A and 46.13 mmHg in group B indicating less endurance capacity in group A compared to group B. Thus, it is found that strength and endurance are less in subjects with neck pain as compared to asymptomatic group.

Subjects with neck pain have an altered neuromotor control strategy during craniocervical flexion characterized by reduced activity in the deep cervical flexors and increased activity in the superficial flexors usually accompanied by altered movement strategies due to which patients with neck pain have reduced endurance capacity (Jull 2008). [4] Due to neuromuscular dysfunction pain occurs in symptomatic group which results in reduced

endurance capacity in subjects with neck pain as compared to subjects without neck pain.

Subjects in the neck pain group had difficulty achieving the higher pressure levels on pressure biofeedback unit. These findings are consistent with the study of Jull G et al. (1999); who found that mean activation score in headache group was 4.2 ± 1.9 mmHg and in control group it was 6.1 ± 1.5 mmHg and mean performance index was determined as 10.6 ± 15.3 in headache group and 54.5 ± 28.6 in the control group. So from this it can be concluded that strength and endurance capacity was less in headache group than the control group. This is because deep neck flexor muscle contraction was significantly inferior in the cervical headache group as compared to controls due to abnormal responses to passive stretching and abnormal muscle contraction in subjects with cervical headache. [5]

Results of our study are similar to the study of Cesar Fernandez-de-las-Penas et al. (2007); who found that mean activation score and mean performance index was 6.6 ± 2.3 mmHg and 32.4 ± 15.8 respectively in patients with chronic tension type headache and the mean activation score and mean performance index was 12.6 ± 4.3 mmHg and 66.8 ± 23.5 respectively in control group. This supports our study that strength and endurance capacity is less in patients with chronic tension type headache as compared to control group. Reduction in strength and endurance is due to impairment of neck flexor muscles in a group of individuals with tension type headache. [8]

Similar results were demonstrated by Thomas Tai Wing Chiu et al. who concluded that the patients with chronic neck pain had a poorer ability to perform the CCFT when compared with asymptomatic subjects. But the median pressure level achieved by the asymptomatic group in that study was 28 mmHg, as compared to 24 mmHg for the subjects in the chronic neck pain group which is not consistent with the present study where the median pressure level for both the groups is 10 mmHg. This may be because in our study the strength was measured at first attempt of pressure increment up to 30 mmHg from baseline of 20mmHg pressure which was held for 10 seconds whereas in their study they considered highest pressure level which was held for 10 sec starting from baseline of 20mmHg to 22mmHg and so on in incremental order up to maximum pressure of 30mmHg. [1] Another reason may be because young and middle age patients were able to increase pressure up to 26mmHg – 30mmHg without using superficial muscles, which is supporting our findings where median pressure is 30mmHg in both the groups. [8]

The CCFT is used for strength and endurance training in patients with neck pain and it shows improvement and it reduces the occurrence of neck pain. This finding is consistent with the study of Grimmer K in 1994; who concluded that the measurements of cervical short flexor endurance were reproducible over a one month interval and there was a systematic improvement in mean endurance capacity for both women and men. [7]

Wontae Gong et al. did a study to find out correlations between cervical lordosis, forward head posture, and cervical range of motion and the strength and endurance of the deep neck flexor muscles in college students and it was found that the posture of the cervical spine affects the endurance rather than the strength of the deep neck flexors. [10]

Falla et al. in 2004 did a study on patients with neck pain to demonstrate reduced electromyographic activity of the deep cervical flexor muscles during performance of the craniocervical flexion test and it was concluded that reduced performance of the craniocervical flexion test is associated with dysfunction of the deep cervical flexor muscles. [11]

Limitations of the study were that we didn't use any sophisticated techniques such as electromyography. For future recommendations study can be done in

subjects having neck pain with different causes such as spondylosis, spondylolysis or prolapsed intervertebral disc because for this study only subjects with mechanical neck pain were taken.

CONCLUSION

Strength and endurance of deep cervical flexors are reduced in neck pain. During the measurement of endurance capacity the subjects had to do more number of repetitions so they were not able to hold at the final pressure till the end of the test which is suggestive of fatigue.

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