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Research article

Efficacy of physiotherapy intervention on craniovertebral and craniohorizontal angle using on protractor mobile app and neck muscle strength in chronic nonspecific neck pain

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ABSTRACT

Introduction and Aim: The chronic nonspecific neck pain is common in all age groups since it is non-specific it may be due to any reasons right from school children to elderly. Factors like muscle strain, worn joints, nerve compression, poor posture, neck pain are found to reduce the cervical angle. The aim of the study is to find the efficacy of physiotherapy intervention on craniovertebral angle, craniohorizontal angle, neck muscle strength and hand grip in subjects with chronic nonspecific neck pain.

Materials and Methods: The subjects with chronic nonspecific neck pain (n=30) were selected randomly from the physiotherapy outpatient department of ACS medical college and hospital as per inclusion criteria and divided into two groups. The pre-test and post-test measurements of craniovertebral and craniohorizontal angles, craniovertebral angle were measured using on protractor mobile app. The neck muscle strength was measured using modified dial sphygmomanometer and hand grip was measured using hand held dynamometer. Group A received craniocervical flexion exercise and group B received stretching and strengthening for a period of 12 weeks. Post test was conducted after 12 weeks.

Results: The comparison within Group A and Group B pre- and post-test values in both groups showed highly significant difference in mean values at $P \leq 0.001$, but group A which has a higher mean value is more effective in craniovertebral angle, craniohorizontal angle, neck muscle strength (Flexor and Extensor) and hand grip.

Conclusion: The craniocervical flexion exercise given to chronic nonspecific neck pain patients was found to reduce neck pain by improving the neck muscle strength, hand grip strength and by correcting the craniocervical and craniohorizontal angles.

Keywords: Chronic nonspecific neck pain; protractor mobile app; neck muscle strength; craniocervical flexion.

INTRODUCTION

World health organization defines that musculoskeletal conditions are typically characterized by pain, limitation of movements and functional ability of an individual. Osteoarthritis, neck pain and back pain are some of the common and disabling musculoskeletal disorders. Among which neck pain is the second common musculoskeletal disorder caused due to many other spinal problems. Neck pain also called as cervicalgia, about two third of world's population lives with neck pain. Neck pain can be acute or chronic depending on the duration of pain. Neck pain is categorized into 4 grades according to its disability and pathology. It is mostly due to muscle tightness in neck as well as in upper back or due to nerve compression in the cervical vertebrae. A person working for long duration consequently acquires neck pain. Prevalence of neck pain is increasing day by day due to various reasons (1). It as higher prevalence of about 30% of world population (2) suffer from neck pain and about 6.8% from rural population (3).

Nonspecific neck pain is induced by nonspecific musculoskeletal disorder(1). In which 37.3% reported with persistent neck pain and 9.9% with aggravation during follow up (2). In western countries 34-54% of the people have been reported to suffer from neck pain (4). The high risk factors of developing nonspecific neck pain are old age, female gender, high job demands, ex-smokers and history of neck disorders (5). Life style changes, increased computer usage, even though certain amount of stress strengthens the musculoskeletal system, more of stress leads to overuse injuries (6). Age group between 40-59 years of working category is commonly found to have neck pain. Identification of risk factors of nonspecific neck pain varies from each individual (5). By controlling the risk factors will prevent chronic symptoms of neck pain (4). Neck problem affect individual's physical, psychological and social functioning (7). Recent study showed decreased neck muscle strength during extension and decreased activity of semispinalis cervicis and multifidus compare to healthy ones in women with chronic neck pain (5). It also reduces flexion, extension ratio, the coefficient of variation was about 25-29%(8). It is also proved that in chronic neck pain patients weakness of neck flexor muscle has increased pain. The neck muscle weakness is also due to wrong working position where there occurs stretch of neck extensor for longer duration which leads to forward position of head and neck(9).The strength of the neck muscle can be measured using modified dial sphygmomanometer.

Forward head posture due to neck pain is one of the common abnormality affecting larger population (4,10). More the forward head, smaller the craniovertebral angle (4). Forward head posture seem to increase postural musculature especially at cervical spine shifting the head forward to the body's centre of gravity (10). Recently the usage of smart phone increased and most of the individuals use their mobile phone closed to their waist or lap shifting their head forward (11). This posture decreases cervical lordosis which causes neck pain, shoulder pain, decrease the craniovertebral angle and weakness of cervical flexor muscles (11). Craniovertebral angle can also be a reason for pain in the cervical region (12).

Craniovertebral and craniohorizontal angles are commonly used in research measure for expressing head on neck posture(7). The normal range of craniovertebral angle is 49.9°(10). It is also believed to estimate head on neck posture on upper cervical spine (6). The between the horizontal line drawn from tragus of ear to external canthus of eye forms the craniohorizontal angle and the angle between horizontal line drawn from the spinous process of c7 vertebra to tragus of the ear forms craniovertebral angle (6). Craniovertebral angle reduction causes cervical vertebra flexion which in turn increase the extensor muscle load (12), recently it is theorized that patient with chronic neck pain develops respiratory dysfunction and also craniovertebral angle impact on vo_2 value during treadmill running test(13). Craniovertebral angle depends on the posture of whole spine (14). So that increase in forward head posture decreases the craniovertebral angle and greater is the disability.

Though there are many tools used for examination and diagnostic purposes. Universal Goniometer is reliable and easily portable instrument used to measure range of motion of joints, software like auto cad for measuring cervical angles(15), lateral view photographic method(16), Sapo software for postural assessment (17) are some of the examples. Protractor mobile app is intended to measure the craniovertebral and craniohorizontal angles of the cervical vertebrae. It is a reliable and validated tool to measure craniovertebral and craniohorizontal angles(15). The on protractor mobile application intraclass correlation coefficient for craniovertebral angle is 0.979 and for craniohorizontal angle is found to be 0.999. Thus, protractor mobile app is a reliable tool to measure craniovertebral and craniohorizontal angle (15).

Craniocervical flexion exercise is found to activate deep flexor muscles in neck pain patients, there is a significant difference in the sternocleidomastoid muscle as it reduced pain by decreasing the muscle tone of the cervical region(18). Craniocervical flexion exercise also increased the craniovertebral angle by improves forward head posture. It is believed that cervical strengthening exercise increases the activity of sternocleidomastoid by preventing weakness of deep flexor muscle which helps to maintain the head in neutral position. Stiffness of neck is also another reason for abnormal neck posture and neck pain (18).

MATERIALS AND METHODS

The study design of this study was a comparative study of pre and post type, conducted in the physiotherapy outpatient department in ACS Medical College and Hospital for the duration of 12 weeks.

This study included 30 subjects based on the inclusion criteria like age 25 to 50 years, those with muscle strain, poor head and neck posture, worn joints and patients with neck pain for past 3 months and excluded those with recent cervical fracture or dislocation, severe neck pain from spinal infection, history of cervical spine surgery, spinal osteoporosis and head and neck injuries. Then by simple random sampling of lottery method they were divided into two groups and a written consent forms were collected duly signed after explaining about the study. Group A underwent craniocervical flexion exercise and group B underwent strengthening and stretching exercise for 12 weeks as 5 sessions per week. Pre and post-test were conducted using protractor mobile app, modified dial sphygmomanometer and hand held dynamometer, in which craniovertebral and craniohorizontal angles were measured using on protractor mobile app marked on c7 and tragus for craniovertebral angle and on tragus and external canthus of eye for craniohorizontal angle (Fig.1).

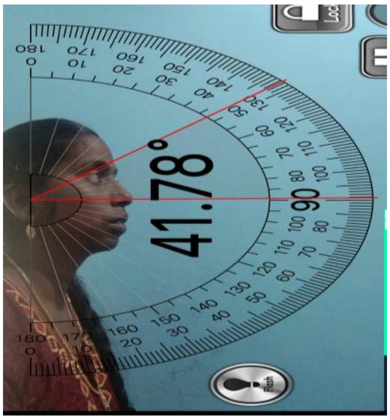

Fig.1: Craniohorizontal angle (CHA)

The neck muscle strength was measured using modified dial sphygmomanometer in sitting position to measure the strength of neck flexors and in supine lying to measure the extensor muscle strength. In sitting position subject was asked to hold the pressure cuff by tucking in chin and asked to hold the bulb in one hand and mamometer gauge in another. Then asked to press against the cuff and hold, thus gave the flexor muscle strength of the neck which points in the mamometer gauge. Same procedure in supine lying, the cuff was placed at neck and bulb and mamometer gauge was given in hand and asked to push against the cuff and hold the mamometer gauge shows the extensor muscle strength. In sitting position hand held dynamometer was used to measure hand grip strength for both the hands separately to know the grip strength of both extremities.

After the pre-test exercise intervention were given for both the groups and asked to follow it for 12 weeks of duration, in which group A underwent craniocervical flexion exercises and group B stretching and strengthening exercises held for 30seconds/10 repetition. The post test conducted after 12 weeks with the same procedure.

Data analysis

The collected data used both descriptive and inferential statistics to tabulate and analyse. Statistical package for social science (SPSS) version 24 were used to assess all the parameters. To find the statistical difference within the groups paired ‘t’ test was adopted and to find statistical difference between the groups independent ‘t’ test (Student’s ‘t’ test) was adopted.

Table 1: Comparison of dependent variables within group A between pre- and post-test values

Variables	Pre-test		Post-test		t test	Significance
	Mean	S.D.	Mean	S.D.		
Craniovertebral Angle	57.70	4.69	51.69	1.15	5.39	.000***
Craniohorizontal Angle	31.14	5.84	22.49	5.11	-16.14	.000***
Neck Flexor	44.66	8.95	59.33	7.76	9.86	.000***
Neck Extensor	45.40	11.06	59.00	10.38	-.425	.000***
Left Hand Grip	19.00	2.61	37.13	.838	-23.25	.000***
Right Hand Grip	19.10	2.63	38.46	1.50	-13.50	.000***

*** $P \leq 0.001$

Table 1 reveals the mean, standard deviation (S.D.), t-value and p-value between pre-test and post-test within group A .There is a statistically, highly significant difference between the pre-test and post-test values within group A (***- $P \leq 0.001$).

Table 2: Comparison of dependent variables within group B between pre- and post-test values

Variables	Pre test		Post test		t test	Significance
	Mean	S.D.	Mean	S.D.		
Craniovertebral Angle	56.90	2.45	51.69	2.69	5.77	.000***
Craniohorizontal Angle	31.52	2.02	28.68	.388	-13.18	.000***
Neck Flexor	46.69	3.06	50.08	.761	4.95	.000***
Neck Extensor	44.82	.548	50.64	.515	-25.63	.000***
Left Hand Grip	19.20	2.36	30.60	1.50	-22.46	.000***
Right Hand Grip	19.30	2.38	31.66	1.17	-15.17	.000***

(*- $P \leq 0.001$)**

Table 2 reveals the mean, standard deviation (S.D.), t value and p value between pre-test and post-test within group B. A statistically highly significant difference is seen between the pre-test and post-test values within group B (***- $P \leq 0.001$).

RESULTS

On analysing the mean values of group A and group B on craniovertebral angle, it shows significant decrease in the post test mean values but (group A craniocervical flexion) shows 52 degree which has the lower mean value is effective than (group B strengthening and stretching) 57.61 degree at $P \leq 0.001$.Hence Null hypothesis is rejected.

On correlating the mean values of group A and group B on craniohorizontal angle, it shows significant decrease in the post test mean values but (group A craniocervical flexion) shows 22.49 degree which has the lower mean value is effective than (group B strengthening and stretching) 28.68 degree at $P \leq 0.001$. Hence Null hypothesis is rejected.

On analysing the mean values of group A and group B on, neck muscle strength (Flexor and Extensor), it shows significant increase in the post test mean values but (group A -craniocervical flexion) shows 59.33 and 59.00 mm Hg respectively, which has the higher mean value is effective than (group B strengthening and stretching) 50.08 and 50.64 mm Hg respectively at $P \leq 0.001$.Hence Null Hypothesis is rejected.

On observing the mean values of group A and group B on hand grip muscle strength (left and right), it shows significant increase in the post test mean values but (group A -craniocervical flexion) shows 37.13 and 30.60 respectively, which has the higher mean value is effective than (group B -strengthening and stretching) 38.46 and 31.66 respectively at $P \leq 0.001$. Hence Null hypothesis is rejected.

On examining the pre-test and post-test within group A and group B on craniovertebral angle, craniohorizontal angle, neck muscle strength (flexor and extensor) and hand grip shows highly significant difference in mean values at $P \leq 0.001$**.**

DISCUSSION

The subjects of total 30 with chronic nonspecific neck pain were selected and included as per inclusion criteria and underwent pre- and post-test measuring craniovertebral angle and craniohorizontal angle and neck muscle strength. Yip and Chiu concluded that reduced craniovertebral angle contributes significant occurrence of pain in the craniocervical area (14). This study showed that the increase or decrease in the cervical angle is one of the reasons for neck pain.

Kim *et al.,* mentioned that limitation of the arthrokinematic movements within the joint capsule and the increased pressure between the facet joint in addition with physiological changes of craniocervical muscles is caused by reduced cervical range of motion of flexion and extension in individuals with forward head posture experiencing pain is considered to be as a result of a decreased craniovertebral angle (12). Yip reported that craniovertebral angle is smaller compared to normal subjects than those with neck pain and clinically significant difference from minimal level of detectable changes were seen(19). This study revealed that neck pain may not only decrease the craniovertebral angle it may also increase craniovertebral angle. Lau *et al.*, found moderate to good negative correlation between craniovertebral angle and neck pain. The studies associating an excessive forward head position with neck pain can be associated with musculoskeletal disorders (20). Yip and Chiu stated that the poor postural awareness and habitual poor postures may result in greater loading on the supporting structure and can cause sensitization and pain cause poor head posture resulting in neck pain(14). Hakala *et al.,* noted that the increased craniovertebral angle in females can be attributed to or partly accompanied with psychosocial issues like stress (21). Akodu *et al.*, observed that the excessive smartphone users had a low craniovertebral angle and those who were non excessive smartphone users had high (normal) craniovertebral angle (11).

Mamania *et al.*, evaluated the inter rater and intra rater reliability for on protractor mobile application for measuring craniovertebral and craniohorizontal angle (15). Suvarnato *et al.*, reported that craniocervical flexor training is essential for improvement of craniovertebral angle and to improve neuromuscular control of deep cervical flexor muscles and to reduce the intensity of pain in chronic neck pain patients. It also significantly improved extensor muscle strength(7). The current study revealed that craniocervical flexion exercise improved in craniovertebral angle, craniohorizontal angle and also the neck muscle strength in chronic nonspecific neck pain patient.

CONCLUSION

Thus this study concludes that craniocervical flexion exercise in chronic nonspecific neck pain patients found to reduce neck pain by improving the neck muscle strength, hand grip strength and by correcting the craniocervical and craniohorizontal angles.

CONFLICT OF INTEREST

The authors declare no conflict of interest

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