Association of Craniovertebral Angle with Neck Pain and Hand Grip Strength in Individuals Working on Computers: An Observational Study Protocol

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Abstract:

Background:

The software sector is growing at a very quick speed. Computers are necessary in every sector. The majority of the day must be spent sitting in front of a computer screen in order to operate on a computer. Prolonged Computer use combined with an inadequate work-rest cycle, particularly when utilizing input devices leads to postural stress due to poor workstation ergonomics which is directly linked to musculoskeletal issues and can cause neck pain and changes in the craniovertebral angle thereby leading to Forward head posture (FHP). It is measured by using modified universal goniometer. Office workers reported a 12-month prevalence of neck pain. In computer professionals, grip strength could be impacted by extended mouse use, protracted typing sessions, and awkward hand placement. The need of this study is to examine the relationship between craniovertebral angle and handgrip strength and neck pain in people who use computers. **Outcome Measures:** craniovertebral angle measured with modified universal goniometer, neck pain using Northwick Park Neck Pain Questionnaire and hand grip strength measured using digital handheld dynamometer. **Statistical Analysis:** The data will be collected and descriptive statistic like mean, standard deviation after ensuring the normal distribution will be analyzed using SPSS version 21 software. Shapiro-Wilk Test will be used to check normal distribution of data. If the data will follow normal distribution then Pearson correlation coefficient will be used and if data does not follow normal distribution then Spearman Correlation will be used to find correlation among normal and abnormal craniovertebral angle, neck pain, right and left hand grip strength. **Conclusion:** This observational study will be helpful for understanding and building up essential information for the association between forward head posture, neck pain and grip strength. **Clinical Trial Registration:** The study is registered with Clinical Trials Registry- India (CTRI), with the registration number for the trial being CTRI/2022/07/044312.

Keywords: CV angle, Forward head posture, computer operators, neck pain, grip strength, dynamometer

Introduction:

The software sector is growing at a very quick speed with approximately 18 million personal computers are being installed, and the number is rising with time [1, 2]. Computers are necessary in every sector. The majority of the day must be spent sitting in front of a computer screen in order to operate on a computer [3]. This combined with an inadequate work-rest cycle, particularly when utilizing input devices

like a keyboard or mouse in extended postures, leads to postural stress due to poor workstation ergonomics has been directly linked to musculoskeletal issues and can cause neck pain and changes in the craniovertebral angle thereby leading to Forward head posture (FHP) [1, 3, 4].

One of the most prevalent cervical irregularities is forward head position, which can result in a variety of pathological problems, including headaches, neck pain [5], temporomandibular joint and vertebral body disorders, scapula and shoulder dyskinesis [6], and changes in the length-strength of soft tissues [7].

The intersection of the horizontal line that passes through the C7 spinous process and the line that passes through the middle of the tragus of the ear forms the craniovertebral angle. It is employed to evaluate the postures of the head and neck [8]. There are various methods employed to measure Craniovertebral angle [1]. It normally ranges from 43.8° to 48.7° [9].

According to reports, the prevalence of neck pain among office workers is 45–63% worldwide and from 50–76% in Australia [10]. A common cause of neck pain frequently found is prolonged computer use for both leisure and daily job tasks. Office workers reported a 12-month prevalence of neck pain of 45.5%, ranging from 17.7% to 63% [11]. The Oswestry Questionnaire served as the model for the Northwick Park Neck Pain Questionnaire (NPQ) is used to measure neck pain severity. To evaluate the patient's symptoms, it consists of nine questions divided into five sections. It is advised to employ the Northwick Park Neck Pain Questionnaire in clinical settings and research projects due to its validity [12].

The majority of daily tasks involve the use of hands. The human hand has the most complex musculoskeletal system and the largest neural structure relative to its size [13]. Each thumb and four fingers make up the hand complex [14]. A strong grasp with one's hands is necessary for many daily tasks. In computer professionals, it could be impacted by extended mouse use, protracted typing sessions, and awkward hand placement. The maximal strength is obtained by the contraction of the hand's intrinsic and extrinsic muscles, which is reflected in the strength of the hand grip [15]. Measurement of hand grip strength is a very practical and proven method that is most commonly utilized in clinical settings [16].

Numerous investigations have assessed how various neck positions affect hand grip strength, with a focus mostly on the neutral and rotational positions of the neck; further studies have examined the relationship between the impact of neck postures on elbow and hand strength [15, 17, 18]. Recently, researchers have verified the Camry Electronic Hand dynamometer as a tool for measuring maximal isometric grip strength. It may compare the current and previous records and evaluate grip strength based on age and gender. For different hand sizes, the instrument offers movable grip sizes [19].

A study by Sakshi Jain et al. (2018) on computer professionals at Tata Power Delhi Distribution Limited, Moti Nagar, found a strong relationship between hand function and neck position in these workers [2]. The usual range of hand grip strength in a healthy Indian population aged 21 to 80 years was assessed by Prachita Walankar et al. (2016) [20].

The need of this study is to examine the relationship between craniovertebral angle and handgrip strength and neck pain in people who use computers. While there is literature indicating notable changes in craniovertebral angle, hand function, and neck pain, there is lack of information pertaining to hand grip strength in computer users.

Objectives of the study are to:

- To measure craniovertebral angle with modified universal goniometer.
- To measure neck pain using Northwick Park Neck Pain Questionnaire.
- To measure hand grip strength using digital handheld dynamometer.

- To analyze association of changes in craniovertebral angle with neck pain and hand grip strength.

Hypothesis:

The null hypothesis is that there is no significant statistical association of craniovertebral angle with neck pain and hand grip strength in individuals working with computer.

Ethical Approval:

All the procedures that will be involved in this trial had been taken approval from the Sumandeep Vidyapeeth Institutional Ethics Committee. The approval received from the Sumandeep Vidyapeeth Institutional Ethics Committee had the outward number, SVIEC/ON/Phys/BNMPT21/D22039 dated on 21/06/2022.

Clinical Trial Registration:

The study is registered with Clinical Trials Registry- India (CTRI), with the registration number for the trial being CTRI/2022/07/044312.

Sample size calculation:

Sample size calculation was done using the following formula,

$$n' = \frac{NZ^2P(1-P)}{d^2(N-1)+Z^2P(1-P)}$$

where n' = Sample size with finite population correction,
N = Population size,
Z = Z statistic for a level of confidence,
P = Expected proportion (If the prevalence is 20%, $P = 0.2$), and
d = Precision (If the precision is 5%, then $d = 0.05$)

After using the above formula for sample size calculation, the final sample size came to be minimum 100 subjects.

Method:

In this cross sectional, observational study, Computer workers of belonging to the age (from 25 years to 60 years from Constituents College's of Sumandeep Vidyapeeth and community surrounding the Institution will be approached and explained about the study.

Inclusion Criteria:

1. Computer workers
2. Age 25-60 years
3. Both genders
4. Working ≥7-8 hours/day from more than 5 years
5. Subjects willing to participate

Exclusion Criteria:

1. Any neurological disorders
2. Previous surgeries of cervical spine or upper limb
3. Cardio-pulmonary disorders
4. Recent trauma to head, neck and upper limb
5. Eye or hearing impairments

The participants who meet the inclusion criteria will be enrolled in the study. The subjects willing to participate in the study will be requested to fill up written informed consent form. Participants will be selected from the population using convenient sampling technique. Participants will be given to the participant's information sheets. The participants will be screened as per the routine musculoskeletal assessment format (fig. 1). All the participants will be assessed for measuring craniovertebral angle, followed by neck pain questionnaire and hand grip strength measurement (table 1).

The Test Procedure is as follows:

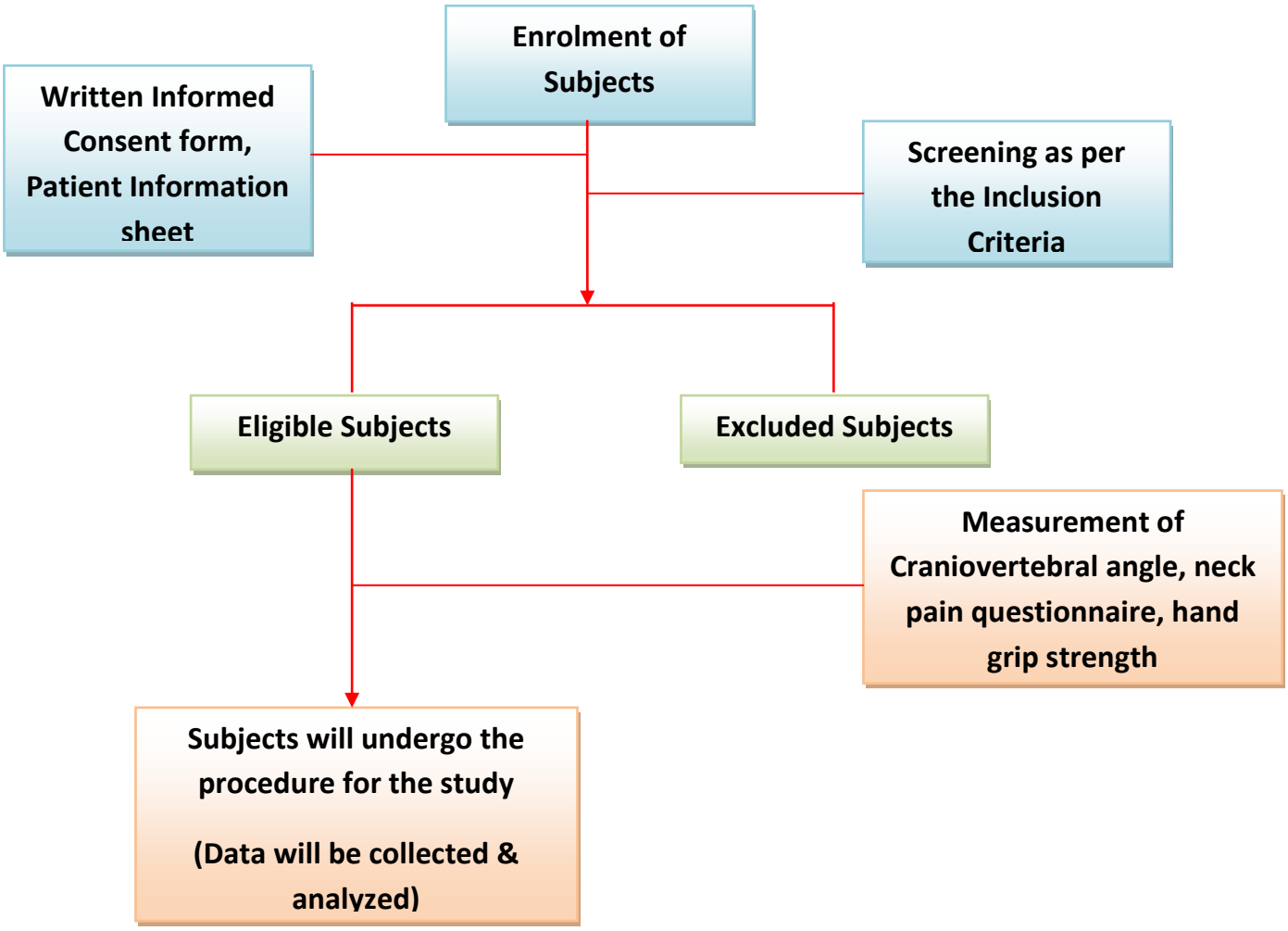
Step 1 – Measurement of Craniovertebral Angle (CVA) [8]

Craniovertebral angle is formed at the intersection of the horizontal line passing through the C7 spinous process and line passing through midpoint of the tragus of the ear.

Modified universal goniometer will be used to measure craniovertebral angle. It is reliable, easily available, cost-effective and alternative to high-end equipment.

- Subject will be sitting straight in chair for measurement of craniovertebral angle.
- C7 vertebrae will be palpated by asking subject to move their head in flexion and extension of cervical spine and marked by marker.

Fig 1: Flowchart summarising the overall trial design



- C7 vertebrae will be taken as fulcrum (Figure 2).
- Craniovertebral angle will be measured by placing modified arm of universal goniometer at the horizontal line passing through the C7 spinous process; horizontal arm will be placed parallel to the ground; movable arm moving towards the head.
- Movable arm will be placed at the line intersecting midpoint of tragus of ear.

Angle made by horizontal and movable arm will be recorded (Figure 3 & 4). [8]

Step 2 – Measurement of Neck pain [12]

Neck pain will be measured by Northwick Park Neck Pain Questionnaire (NPQ), it is reliable and valid.[25]

- It includes 9 sections about activities of daily living that may affected by neck pain.

Fig 2

Fig 3

Fig 4

Fig 5

Fig 2: shows Placement of modified universal goniometer, whereas Fig: 3 & 4 shows measurement of CVA, Fig 5 shows grip strength measurement

- In every section there is 1 question with 5 as possible answers.
- Participants choose most precise answer with their current situation. In every section there is 0-4 scale, 4 is greatest disability. Total score of individual is summation of all 9 section scores obtained out of 36 (Total score of NPQ).
- Percentage of score will be calculated by dividing individual's score with total score of NPQ. It depends on the number of sections answered.
- Question 10 will not be asked as this is one time observational study and this question is for follow up assessment.
- Thus the scoring will be done by answering only first 9 questions.

Example:

If total section answered is 9 then percentage is;

$$\frac{total\ score\ of\ individual}{36} * 100$$

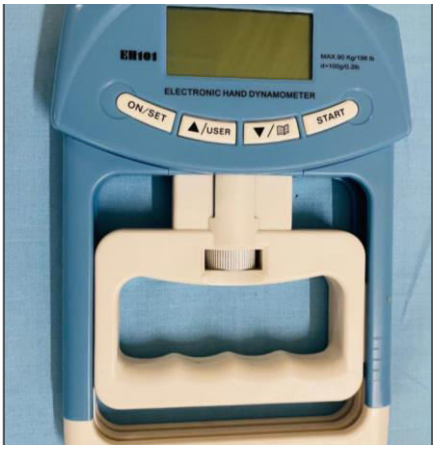
If one section is not answered then percentage is;

$$\frac{total\ score\ of\ individual}{32} * 100$$

Step 2 – Measurement of Hand grip strength [19]

Hand grip strength will be measured by CAMRY digital handheld dynamometer (fig. 6). Interclass correlation coefficients (ICCs) was found to be .95 showing excellent reliability.

Figure 6: CAMRY digital hand held dynamometer



- Subject will be sitting on chair without armrest or on a stool with feet supporting on floor.
- Demonstration of how to use instrument will be given prior to assessing hand grip strength.
- Standardized individual's position given by American Society of Hand Therapists (ASHT) is (Figure 5)

  "The patient will be chair seated with his/her shoulders adducted and 0° neutrally rotated, elbow will be flexed at 90° and the forearm and wrist will remain in neutral position." [21]
- Three readings will be taken at both the hands and average will be counted from those values.

After performing the assessment for Craniovertebral Angle, Northwick Park Neck Pain Questionnaire and Hand grip strength which are also going to be the outcome measures for this study, the obtained neck muscles endurance will be recorded.

Table 1: the schedule of enrolment, interventions and assessments in accordance with the Standard Protocol Items: Recommendation for Interventional Trials (SPIRIT) for the Observational Study

Time Point	**Study Period**			
		Enrolment	**Day 1**	**Later if applicable**
Enrolment	Eligibility Screen	×		
	Informed Consent	×		
	Patient Information Sheet	×		
Intervention	Intervention if any		Not applicable	
Assessments	Baseline	×		
	Craniovertebral Angle		×	
	Northwick Park Neck Pain Questionnaire		×	
	Hand grip strength		×	

Statistical Analysis:

The data will be collected and entered in Microsoft excel sheet and descriptive statistic like mean, standard deviation after ensuring the normal distribution and analysis will be done by using SPSS version 21 software by taking the help of a Biostatistician. Shapiro-Wilk Test will be used to check normal distribution of data. If the data will follow normal distribution then Pearson correlation coefficient will be used and if data does not follow normal distribution then Spearman Correlation will be used to find correlation among normal and abnormal craniovertebral angle; neck pain; right and left hand grip strength.

Discussion:

On completion of this observational study the results of this study will give more clarity on correlation between alterations in craniovertebral angle; neck pain and hand grip strength. The association between altered CV angle affecting neck pain and hand grip strength will be a helpful tool in the assessment of subjects suffering from neck pain. To the best of our knowledge we did not find any systematic review which showed any association among them. The results of this study will also be essential for the persons using computers for the prolonged duration and having forward head posture with or without neck pain.

The strength of this study protocol is that it follows the SPIRIT protocol. The study also follows all the recommendations for observational studies considered in the Strengthening the Reporting of Observational studies in Epidemiology (STROBE) statement.

Conclusion: This observational study will be helpful for understanding and building up essential information for the association between forward head posture, neck pain and grip strength.

Conflicts of Interest:
The authors hereby state that we have no potential conflicts of interest to declare.

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