

Photogrammetric Quantification Analysis of Forward Head Posture Among Healthy Participants and Subjects with Neck & Shoulder Pain- A Strobe Cross Sectional Study

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Abstract

Background: Musculoskeletal structures can change into an incorrect shape due to a reduction in physical activity and inappropriate posture habits in daily living.

Aim of the study: To study and investigate the forward head posture which is related to shoulder and neck pain.

Materials and Method: The design of this study was observational cross-sectional study and conducted in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology Statement (STROBE). The study was conducted between January 2023 and March 2023. A total of 65 participants (42 males, 23 females) aged 18- 35 years. Neck pain was measured using Neck Disability Index (NDI), shoulder pain was measured using DASH questionnaire, Forward Head Posture (FHP) was measured using CVA angle by photogrammetry. The results were compared and correlated using appropriate statistical tools. For data analysis, the computer program Statistical Social Science Package (SPSS) (19 windows version) has been used. The p value was considered < 0.01 considered quite significant.

Conclusion: Cervical and shoulder pain, which is the causative factor to increase forward head posture and significant discomfort in all the participants.

Keywords

FHP – Forward Head Posture , CVA – Craniovertebral Angle , NDI – Neck Disability Index, DASH- Disability Of Arm Shoulder And Hand

Introduction

“A good posture is defined as keeping one's ears aligned with the shoulders and having the angel wings or shoulder blades retracted” (Salvi and Battin, 2018). A Good posture and stance reflect a proper state of mind. Due to poor biomechanics, the pain arises and reduces the efficiency of movement misalignment of body parts, leading to additional muscle work, which may cause structural and functional complications. Posture is the alignment of body parts and is a significant

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health indicator; it should match with a specific body position in the space that minimizes antigravity stress on body tissues. Inadequate posture consists of poor interrelations between parts of the body. These will cause muscle tension and shortening, which makes appropriate joint movements more difficult to achieve and may cause pain (Ruivo et al., 2014).

This posture reduces the dispersion of biomechanical loading and therefore causes degeneration of the neck muscles and abnormal structural changes along with pain. Specifically, the deep cervical flexors and scapular retractors are weakened, and the sternocleidomastoid muscle has increased tension and thickness. The abnormal responses to neck pain are due to protective reactions of hyperactivity and inhibition of muscle to prevent damage to the body or reduce pain. This causes mal-alignment of the neck, a tilting in posture, and an imbalance of the muscles and leads to neck pain (Kang et al., 2018).

The forward head posture (FHP) is being shown to be a general posture displacement, and the typical estimate is about 66% of the patient population. The estimated 1-year incidence of neck pain ranges between 10.4 and 21.3%, and the overall prevalence of neck pain in the general population can be as high as 86.8% (Hoy et al., 2010; Genebra et al., 2017). Forward head posture (FHP) is a kind of poor posture associated with increased kyphosis in the thoracic spine and anterior shoulder position (Ramalingam and Subramaniam, 2019; Lynch et al., 2010), which is the upper trapezius, splenius capitis, semispinalis capitis, and cervical erector spinae. It is associated with the shortening of the levator scapulae (Falla DL et al., 2004). If the cervical spine is in extension for a long time, it can lead to FHP (Singla and Vegar, 2017). Poor posture is also associated with altered scapula position in terms of kinematic and muscle activities (Kia et al., 2019). There was an increased extension of the atlantooccipital joint and the upper cervical vertebrae along with flexion of the lower cervical vertebrae and upper thoracic vertebrae in subjects with Forward Head Posture (Ramalingam et al., 2021; Lee, 2016).

People often lean their shoulders forward or move their necks frequently when sitting in the work environment, such as when driving or working in front of a computer or desk for long periods, and use desks and chairs unsuitable for their body types, as well as inappropriate bending. These poor lifestyle habits may cause muscle spasticity in the neck and shoulders and induce muscle fatigue that hampers practical biomechanical functions, and this may weaken soft tissues (Hur, 2006).

STROBE inappropriately, as a methodological quality-assessment tool. The inappropriate interchangeable use of the terms ‘methodological quality’ and ‘reporting quality’ is common and may explain why some researchers used STROBE to assess the methodological quality or as a guideline to design and conduct observational research. Reporting quality refers to the completeness to which a study has been given and whether major items for properly appraising the internal and external validity of findings were reported(Williams, 2010).

The Strengthening and Reporting of the Observational Studies in Epidemiology (STROBE) guidelines were created to aid the author in ensuring a high-quality presentation of the conducted observational study. These guidelines consist of 22 checklist items to act as a validation tool to do the framework and conduct the study, especially to identify the strengths and weaknesses of the study.

Therefore, forward head posture due to an imbalance in the muscles around the neck may be related to shoulder and neck pain. This study investigates the forward head posture related to shoulder and neck pain between participants with FHP and healthy adults.

Methodology

This cross-sectional study was conducted among 65 participants (42 males, 23 females) from SRM Medical College & Hospital (SRMIST), SRM Physiotherapy OPD. This study has no risk and was approved by SRM Institutional ethical research committee. By using a simple random sampling method, both gender's age ranges from 18 to 35 years. Initial screening was done to judge eligibility to participate in the study, then, a full verbal explanation of the study and assessment procedure was given to participants. If a participant agreed to be enrolled in the study, an informed consent was signed.

Inclusion criteria: Craniovertebral angle [CVA is $<49^\circ$, if one participant perceives that the neck is curved and shoulder pain with (NRS >3)]. Both Male and female subjects was included.

Exclusion Criteria: History of injury or surgery, shoulder and neck pain secondary to other conditions (e.g., neoplasm, neurological diseases, or vascular diseases), a neurological deficit, infection, or inflammatory arthritis (Ramalingam et al., 2023).

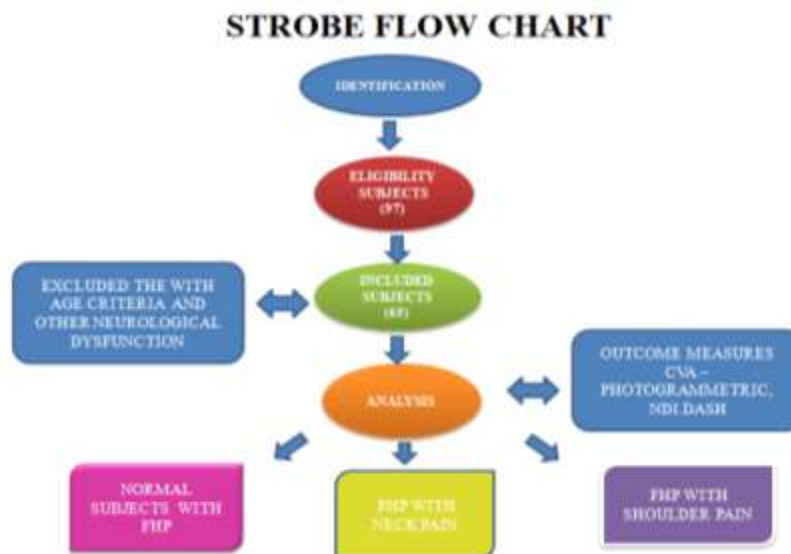


Figure 1. Strobe flow chart

Outcomes Measures: Craniovertebral angle (CVA) (photogrammetry method), Neck Disability Index scale (NDI), Disabilities of the Arm, Shoulder and Hand (DASH) questionnaire, Numerical pain rating scale (NRS). The open-access Kinovea software applied assessment of CVA. The photogrammetry method is a valid and reliable tool for assessing CVA.

Photograph Procedure & Assessment of CVA: Photos were processed through a photogrammetric analysis using software for postural assessment that is reliable and quantifiable measurements for evaluating CVA.

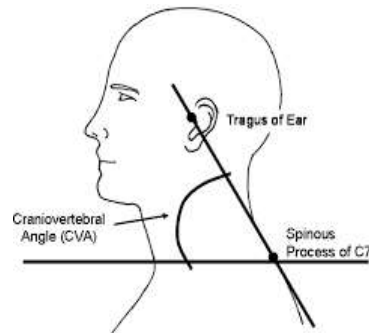


Figure: 2

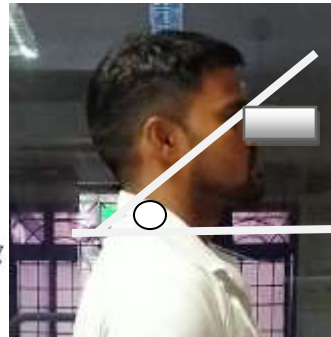


Figure: 3

First, subjects were instructed to stand with the side of the trunk facing the camera and to look at a target fixed in front (Kuo et al., 2009). The researcher asked the subject to flex and extend the neck for few times before assuming the standing resting posture. All participants were instructed, prior to photo capturing, to assume a relaxed resting posture while looking forward at the target with the armrest beside the body. Then, three sagittal plane photos were taken by the digital camera from each side and saved to a personal computer for further analysis. Repeated photographs aimed at reducing bias due to the subject's tension during photography capturing as well as to overcome the difference between measurements because of postural swaying (Verma et al., 2012).

To assess the severity of FHP, the CVA were measured: The CVA was measured as the angle between an imaginary line extending from C7 through the tragus and the horizontal line. The CVA values indicate the head's position, which is relative to the trunk. The smaller the CVA, the greater the FHP (Youssef, 2016; Nam et al., 2013).

DASH is a questionnaire-type tool to evaluate the dysfunction of the upper extremity and the degree of disability in areas of the upper extremity. It has 30 basic items and eight optional items was used in this study. NDI is a self-rated, condition-specific functional status questionnaire with ten items. The NDI has sufficient support and usefulness to retain its status as the most commonly used self-report measure for neck pain.

Results

The total sample size (65 subjects) was calculated at $\alpha=0.05$. Results are expressed as mean $\pm$ standard deviation. For data analysis, the computer program Statistical Social Science Package (SPSS) (19 windows version) has been used. The p value was considered < 0.01 considered quite significant.

Table: 1 Demographic Data (Mean and Standard Deviation)

	Normal Subjects with FHP(15)	FHP with Shoulder Pain(22)	FHP with Neck Pain(28)
AGE	19.25±0.58	20.25±0.67	20.35±1.40
BMI	21.59±2.8	21.87±2.94	24.14±3.53

Table: 2 Comparison Between the Groups with Parameter (Mean and Standard Deviation)

	CVA	DASH	NDI
Normal Subjects with FHP(15)	40.21±3.70	46.74±5.77	48.36 ± 2.77
FHP With Shoulder Pain (21)	46.39±1.92	56.04±4.17	59.05±8.17
FHP With Neck Pain (29)	54.12±2.70	42.84±7.67	48.78±8.98

Correlation analysis: correlations for each CVA, DASH & NDI group evaluated in this study. FHP participants showed there is a significant correlation between DASH and CVA ($r = -0.756$, $p = 0.001$)

Linear Regression analysis: In FHP participants, DASH and CVA proved a significant relationship with shoulder & neck pain. The coefficient of determination (R^2) was 0.530 ($p = 0.001$), and the regression equation was statistically significant, but the explanatory power was not high. The regression equation of the FHP group is that CVA decreases as DASH & NDI increase with a regression coefficient of 0.139.

Discussion

This is a comparative cross-sectional study. The main outcome measure used was the difference in CVA, DASH & NDI. Healthy participants and patients with shoulder and neck pain were assessed. FHP causes musculoskeletal pain by applying a load to the cervical spine and causes mal-alignment and postural displacement. Therefore, in this study, the correlation was investigated through the difference between the craniovertebral angle, neck pain, and shoulder pain between participants with FHP and healthy individuals.

STROBE guidelines ascertained high-quality reporting of observational studies. The Strengthening Reporting of Observational Studies in Epidemiology (STROBE) guidelines were developed following a collaborative initiative of epidemiologists, statisticians, researchers, and journal editors in 2004 (Vandenbroucke et al., 2007). These guidelines were created to aid in the presentation of the conducted observational study to ensure adequate reporting (what was planned, done, found, and concluded) as well as assessment of the strengths and weaknesses of the study

(Cuschieri, 2019). Neck musculoskeletal disorder and cervical dysfunction lead to forward head posture, thoracic kyphosis, and rounded shoulder posture. These were caused by the imbalance of pectoralis major, pectoralis minor, posterior neck muscles, and middle fibers of the trapezius muscle. FHP causes musculoskeletal pain by applying a load to the cervical spine and causes malalignment such as postural displacement, changes the kinematics of the shoulder joint, causing the limitation of the range of motion and pain (Kim and Lee, 2021). Therefore, in this study, the correlation was investigated through the difference between the craniovertebral angle with shoulder & Neck pain between participants with FHP and healthy subjects.

(Kim and Kim, 2016) We assessed the degree of the rounded shoulder by the height of the acromion of the dominant shoulder joint that was measured in the supine position. In our study, photogrammetry was used to assess shoulder angle instead of supine position. (Ruivo et al., 2014) stated that to study the misalignments of body segments, the photographic measurement of sagittal postures of the cervical spine and shoulder is becoming more widespread, with several studies confirming the high reliability of photogrammetry.

The photographic measurement of sagittal postures in the cervical spine and the shoulder is being increased in order to study misalignments on body parts, with several studies confirming that photogrammetry is highly reliable. In this study, there was a decrease in Craniovertebral angle, which is similar to this study that leads to shifting of COG anteriorly, and consequently affects torque that will decrease the craniovertebral angle and forward head posture (Elhafez and Mahmoud, 2020). A significant difference in DASH & NDI was found in previous studies on FHP that posture change can alter the muscle activation pattern. In this study, we found that there was a significant difference in CVA & SA, with DASH & NDI comparison between the groups ($p < 0.05$).

In addition, through regression analysis, it was found the DASH/NDI and CVA had a statistically significant relationship, and an increase in shoulder & neck pain caused an increase in FHP. It is found in our study FHP may be due to an imbalance of muscles around the neck may be related to shoulder pain.

Limitations & Further Recommendations

The sample size was too small, and we need to focus on contributing factors to this high prevalence of FHP. In the future, experimental studies may be conducted to study the effect of different exercise protocols for improving head and shoulder posture. Flexibility, mobility, and strength of the shoulder, scapular, and neck muscles can be considered along with neck pain

Conclusion

The present study can be a preliminary study investigating CVA and the effects of pain. Even though cervical and shoulder pain is the causative factor to increase FHP and significant discomfort in all the participants. Due to the postural abnormality, which affects the daily work routine activities. Therefore, a decrease in Craniovertebral angle certainly leads to an increase in forward head posture.

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