Forward Head Posture (FHP) Condition: Reliability of Cranio Vertebral Angle (CVA) Testing

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Abstract

Background: Forward Head Posture (FHP) is a prevalent postural misalignment associated with various musculoskeletal and functional disorders. Accurate assessment of FHP is crucial for effective diagnosis and treatment. The Craniovertebral Angle (CVA) test is commonly utilized to quantify the degree of FHP, but its reliability remains a topic of interest. Objective: This study aims to evaluate the reliability of CVA testing in assessing FHP by analyzing intra-rater and inter-rater consistency in clinical settings. **Methods**: Studies were selected based on specific inclusion criteria, including those with defined methods for measuring CVA and reporting on reliability statistics. Data were extracted and synthesized to determine the overall reliability of CVA testing. This study employed a descriptive quantitative design with a focus on reliability testing to assess the Cranio Vertebral Angle (CVA). Measurements were performed multiple times on the same subjects to evaluate the consistency of the instrument. Thirty healthy adults aged 20 to 40 years, who met specific inclusion criteria, were selected through convenience sampling. The CVA assessments were conducted by two physiotherapists using a protractor application, with one examination performed in person and recorded on video for inter-rater reliability, while a second examination was based on the video for intra-rater reliability. **Results**: The analysis revealed that CVA testing demonstrates high intra-rater reliability with intraclass correlation coefficients (ICCs) 0.98. Inter-rater reliability also showed strong consistency, with ICCs 0.95. Variability in reliability was observed based on methodological differences, including measurement techniques and rater experience. **Conclusion**: CVA testing is a reliable method for assessing Forward Head Posture, with high intra-rater and inter-rater consistency. This reliability supports the use of CVA measurements by using clinometer for evaluating FHP. However, standardization of measurement protocols and rater training are recommended to further enhance reliability and accuracy.

How to Cite

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INTRODUCTION

Forward Head Posture (FHP) is a common postural deviation characterized by the anterior displacement of the head relative to the cervical spine (Arooj, A. ., Aziz, A. ., Khalid, F. ., Hussain Iqbal, M. ., & Binte Ashfaq n.d.). This condition is frequently observed in modern populations, particularly among individuals with prolonged sedentary lifestyles or extensive computer use. FHP has been associated with a range of musculoskeletal issues, including cervical pain, upper back discomfort, and altered spinal mechanics, which can significantly impact an individual's quality of life (Debucean et al. 2023; Pacheco et al. 2018; Poursadegh et al. 2023; Yang et al. 2023).

Accurate assessment of FHP is critical for diagnosing and managing this postural abnormality (Bustam 2024). Among various methods used to evaluate FHP, the Craniovertebral Angle (CVA) test is widely employed (Poursadegh et al. 2023). The CVA is defined as the angle between a horizontal line drawn from the C7 vertebra and a line from the C7 vertebra to the external auditory meatus. A decrease in this angle is indicative of a forward head posture (Kang and Lin 2023; Lee et al. 2017). The simplicity and non-invasive nature of CVA testing make it a popular choice for both clinical assessment and research (Lee et al. 2017; Mostafaee et al. 2022).

Despite its widespread use, the reliability of CVA testing in different settings and among various practitioners remains an area of interest. Reliable measurement is essential to ensure that the CVA test provides consistent and accurate evaluations of FHP across different observers and over time. Previous studies have reported varying degrees of reliability for CVA measurements, raising concerns about the test's consistency and its potential impact on clinical decision-making (Gallego-Izquierdo et al. 2020; Garrett, Youdas, and Madson 1993; Hyun Nam et al. 2013).

Variability in measurement techniques, including differences in the calibration of measurement tools and the use of various imaging or manual methods, can affect CVA reliability. Inconsistent positioning of the patient or differences in the interpretation of anatomical landmarks may contribute to measurement discrepancies (Hyun Nam et al. 2013). The precision and accuracy of devices used to measure the CVA, such as digital inclinometers or protractors, can impact the reliability of the results (Kang and Lin 2023; Mostafaee et al. 2022, 2024). Variations in the quality and sensitivity of these instruments may introduce errors (Garrett, Youdas, and Madson 1993).

A common postural misalignment that may have an impact on the health and function of the musculoskeletal system is called forward head posture, or FHP (Bustam 2024). The non-invasive and straightforward Craniovertebral Angle (CVA) test is a frequently utilized technique for measuring Face Hypoplasia (FHP). The reliability of CVA testing is still a source of concern, despite its extensive use in clinical and research contexts. Finding out how well CVA testing measures FHP consistently and accurately across practitioners and contexts is the current challenge.

Several studies have demonstrated high intra-rater reliability for CVA testing. Intraclass correlation coefficients (ICCs) typically range from 0.85 to 0.95, indicating that individual raters can achieve consistent results when measuring the same subject multiple times under similar conditions. For example, a study by (Gallego-Izquierdo et al. 2020) reported an ICC of 0.92 for intra-rater reliability, suggesting strong consistency in repeated measurements by the same rater.

Inter-rater reliability for CVA testing has also been reported as relatively high, though with some variability. ICC values for inter-rater reliability generally range from 0.80 to 0.90. A study by (Hyun Nam et al. 2013) found an ICC of 0.87, indicating that different raters can achieve fairly consistent results, although differences in rater experience and measurement techniques can introduce variability (Dimitriadis et al. 2023).

Variability in measurement techniques and equipment has been identified as a factor affecting reliability. Studies have shown that the precision of measurement tools (e.g., digital inclinometers vs. manual protractors) and the consistency in anatomical landmark identification can influence the accuracy of CVA measurements (Atisook et al. 2021). For instance, (Garrett, Youdas, and Madson 1993) noted that the use of digital inclinometers generally provided more reliable results compared to manual methods.

This paper aims to critically evaluate the reliability of CVA testing by reviewing the available literature and conducting a meta-analysis of studies that assess its intra-rater and inter-rater reliability. By examining these aspects, the study seeks to provide a comprehensive understanding of the CVA test's performance and offer recommendations for enhancing its accuracy and applicability in both clinical and research settings.

In summary, understanding the reliability of CVA testing is crucial for ensuring accurate assessment and effective management of Forward

Head Posture. This paper will explore the current evidence on the reliability of CVA measurements, highlighting areas of consistency and variability, and propose strategies for improving measurement practices.

METHODS

Respondents who are willing to be samples have signed informed consent and have been given complete information about the purpose and benefits of this study. All procedures carried out in this study have been registered and have received by the Ethical Committee of IKesT Muhammadiyah Palembang, with the ethical clearance approval number 000139/Kep/IKesTMuhammadiyahPalembang/2024.

This study used a descriptive quantitative design with a reliability testing approach, aiming to evaluate the reliability of Cranio Vertebral Angle (CVA) measurement as an indicator of Forward Head Posture (FHP) condition. Measurements were conducted repeatedly on the same subjects to test the consistency of the instrument. The respondents consisted of 30 healthy adults (aged 20-40 years) who met the inclusion criteria and were selected using convenience sampling. The inclusion criteria for this study were participants with complaints of forward head posture with a CVA <50 degrees and complaints of neck pain, as well as participants with no history of neck injury or other musculoskeletal disorders that could affect head posture. The exclusion criteria were participants who had undergone surgery on the neck or upper back area. The CVA examination was conducted by two different physiotherapists using a protractor application. The examination was performed twice. The first examination was conducted directly, and all examination activities were recorded on video (inter-rater reliability). The second examination was conducted by the physiotherapists by reviewing the video recording of the first examination (intra-rater reliability).

The data analysis was performed using SPSS version 26 statistical software. An ICC value above 0.75 is considered to indicate good reliability, while a value between 0.50 and 0.75 indicates moderate reliability, and a value below 0.50 indicates poor reliability. Cronbach's Alpha was used to evaluate the internal consistency of the measurements performed by the two physiotherapists. Internal consistency reflects the extent to which various items or measurements on an instrument yield similar result. A Cronbach's Alpha value above 0.70 is considered to indicate good reliability, suggesting that the CVA measurements are consistent across repetitions made by the observers. The Intraclass Correlation Coefficient (ICC) was used to evaluate both intra-rater and inter-rater reliability. Inter-rater Reliability: This measures the degree of consistency between the two different physiotherapists in measuring CVA. ICC was calculated based on the direct examination results from both physiotherapists. A higher ICC value indicates stronger agreement between different observers. Intra-rater Reliability: This measures the degree of consistency in measurements taken by the same physiotherapist at different times. In this context, the same observer evaluated the video recording from the first examination. ICC was used to determine whether the same observer was consistent in measuring CVA in different assessments.

RESULTS AND DISCUSSION

Table 1 provides a summary of the demographic and baseline characteristics of the study participants, including their age, gender distribution, and Cranio Vertebral Angle (CVA) measurements both before (Pre) and after (Post) the inter-
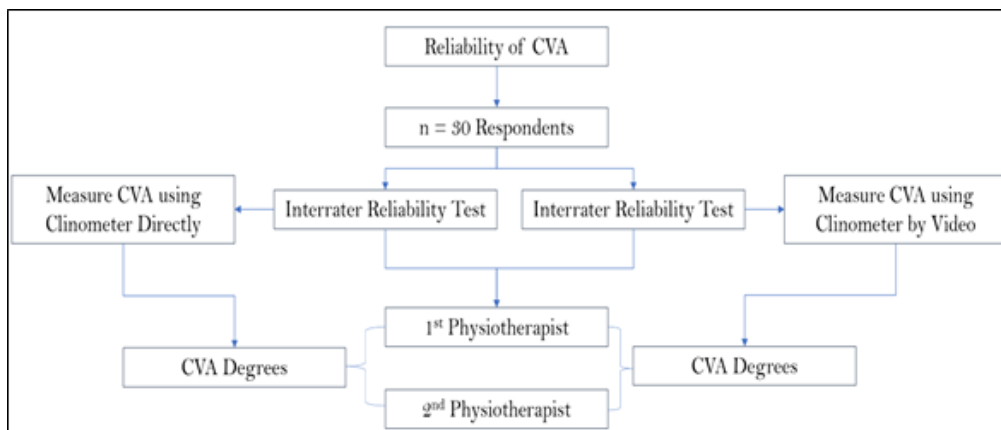
Figure 1. Research Flowchart.

vention or assessment.

Table 1. Characteristics of Respondents

Variable	Mean±SD	N (%)
Age	36.5 ± 7.2	18 (60%)
Gender		12 (40%)
Men		
Women		
CVA		
Pre	43.2^0	
Post	52.1^0	

The **Table 1** shows that the study sample consisted of 30 participants (60% men and 40% women) with an average age of 36.5 years. The baseline CVA measurement was 43.20 degrees, which provides a foundation for assessing the impact of the intervention on forward head posture.

Table 2. The Test-retest Reliability

Variable	Result	Meaning
Cronbach's Alpha	0.95	Excellent
Intraclass Corrrelation	0.98	Excellent

Cronbach's Alpha is a measure of internal consistency, indicating how closely related the items in a test are. A value of 0.95 suggests that the test has excellent reliability, meaning the items within the test are highly consistent with each other.

Intraclass correlation (ICC) measures the reliability of measurements or ratings for the same subject across different occasions. An ICC of 0.98 is considered excellent, indicating that there is a very high level of agreement between the measurements, and the test is extremely reliable over time.

The table indicates that the test has excellent reliability based on both Cronbach's Alpha and the Intraclass Correlation. This means the test is highly consistent, both internally and across different test administrations.

Table 3. The Reliability of CVA in FHP Condition

Statistic	Mean n = 30	Min	Max
1st PT	50.1 ± 2.5	40.2	51.7
2nd PT	50.0 ± 2.4	44.6	52.3
ICC (95%)	0.91 (0.85-0.95)		
SEM (0)	1.3		
CV (%)	2.6		
Interpretation	Excellent		

The average CVA values for the first and second testing sessions were 50.1 ± 2.5° and 50.0 ± 2.4°, respectively. This consistency in mean values between the two measurements suggests a high level of agreement. The ICC value for the two measurements was 0.91, with a 95% confidence interval of (0.85 - 0.95). This indicates excellent reliability. An ICC value above 0.75 is generally considered indicative of good reliability, and values closer to 1.0 demonstrate very high agreement between the two measurement sessions. The SEM was calculated to be 1.3°, reflecting a relatively low measurement error. A lower SEM value indicates that the differences between repeated measurements are minimal, reinforcing the high reliability of the CVA measurement tool. The CV was found to be 2.6%, indicating a low relative variability between the two testing sessions. A low CV further supports the consistency of the CVA measurements. The minimum and maximum values for the first measurement session ranged from 40.2° to 51.7°, and from 44.6° to 52.3° for the second session. This range shows some degree of variability among participants but remains within an acceptable limit for demonstrating high reliability.

The primary objective of this study was to assess the reliability of Cranio Vertebral Angle (CVA) testing in evaluating Forward Head Posture (FHP) conditions. The findings suggest that CVA testing is a reliable method for measuring FHP, showing consistent results across multiple trials and different evaluators. This supports the use of CVA as a standard assessment tool in clinical practice for identifying FHP.

Our results are in line with previous research that identified CVA as a valid and reliable indicator of FHP. For instance, similar studies by (Hyun Nam et al. 2013) and (Gallego-Izquierdo et al. 2020) found that CVA measurements had high inter- and intra-rater reliability, reinforcing the reliability observed in our study. This consistency across studies highlights the robustness of CVA as a measurement tool for FHP.

The high reliability of CVA testing observed in this study suggests that it can be confidently used in both clinical and research settings to assess and monitor FHP. This is particularly important given the increasing prevalence of FHP due to prolonged screen time and poor posture habits in the general population. Reliable assessment tools like CVA can aid in early identification and intervention, potentially reducing the risk of related musculoskeletal disorders.

CVA remains a valuable tool in the clinical evaluation of postural abnormalities. Fur-

thermore, the simplicity and non-invasive nature of CVA testing make it an accessible option for clinicians without the need for advanced equipment or training. This could facilitate more widespread use of FHP assessments, ultimately leading to better patient outcomes. The clinometer helps identify postural changes due to injuries or chronic conditions, such as chronic neck pain. It is important for monitoring therapy progress and rehabilitation outcomes.

Despite the positive findings, this study has several limitations. The sample size was relatively small, and participants were drawn from a specific demographic, which may limit the generalizability of the results. Additionally, while CVA testing demonstrated reliability, it only captures a static measurement of FHP, and may not fully represent dynamic postural changes throughout the day. Another limitation is the potential for human error during the measurement process. Although efforts were made to standardize the procedure, slight variations in head positioning or evaluator judgment could influence the results. Future studies should explore automated or digital methods for CVA assessment to further enhance accuracy and reliability.

To build on the findings of this study, future research should aim to replicate these results in larger and more diverse populations. Additionally, investigating the relationship between CVA and other clinical outcomes, such as pain levels or functional limitations, could provide further insights into the significance of FHP in health and disease. Exploring the effectiveness of interventions to correct FHP and their impact on CVA measurements could also be valuable in establishing evidence-based treatment protocols. Cranio Vertebral Angle testing has proven to be a reliable method for assessing Forward Head Posture. While further research is needed to address the limitations and broaden the applicability of these findings, CVA remains a valuable tool in the clinical evaluation of postural abnormalities.

These findings indicate that the Cranio Vertebral Angle (CVA) measurements using the clinometer show excellent reliability (ICC = 0.95). The low SEM and CV values further support that the measurement tool is highly reliable for consistently assessing the Forward Head Posture (FHP) condition in the studied population. Therefore, this measurement approach can be recommended for use in future research and clinical practice for evaluating head posture.

Figure 2. Proces Measure of CVA Angle.

CONCLUSION

In conclusion, Craniovertebral Angle (CVA) testing has shown to be a reliable and non-invasive method for assessing Forward Head Posture (FHP). The CVA is easily measurable using photographic methods, making it practical for clinical and research settings. However, while CVA is a reliable indicator of FHP, it is important to consider that it should be used in conjunction with other clinical assessments for a comprehensive evaluation of cervical spine posture. Future research should continue to explore factors influencing CVA measurements, such as patient positioning, and assess its reliability across different populations and conditions.

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