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The Intra- and Inter-rater Reliabilities of the Forward Head Posture Assessment of Normal Healthy Subjects

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Abstract. [Purpose] Assessment of posture is an important goal of physical therapy interventions for preventing the progression of forward head posture (FHP). The purpose of this study was to determine the inter- and intra-rater reliabilities of the assessment of FHP. [Subjects and Methods] We recruited 45 participants (20 male subjects, 25 female subjects) from a university student population. Two physical therapists assessed FHP using images of head extension. FHP is characterized by the measurement of angles and distances between anatomical landmarks. Forward shoulder angle of 54° or less was defined as FHP. Intra- and inter-rater reliabilities were estimated using Kendall's Taub correlation coefficients. [Results] Intra-class correlation of intra-rater measurements indicated an excellent level of reliability (0.91), and intra-class correlation of inter-rater measurements showed a good level of reliability in the assessment of FHP (0.75). [Conclusion] Assessment of FHP is an important component of evaluation and affects the design of the treatment regimen. The assessment of FHP was reliably measured by two physical therapists. It could therefore become a useful method for assessing FHP in the clinical setting. Future studies will be needed to provide more detailed quantitative data for accurate assessment of posture.

Key words: Forward head posture, Reliability, Posture assessment

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INTRODUCTION

Individually-habituated resting head posture is believed to be determined by a dynamic combination of factors, including body build, muscle performance, age-related structural changes, occupation, and cultural factors[1–3)]. Forward head posture (FHP) is one of the most common postural problems described as a posture disorder, and in FHP the cervical spine is offset in the anterior direction[4, 5)]. FHP is commonly adopted by computer workers, and it involves a combination of lower cervical flexion, upper cervical extension and rounded shoulders; also, it has been anecdotally linked to musculoskeletal dysfunctions, such as upper crossed syndrome[6)].

Recently, several studies have reported that FHP contributes to the onset and perpetuation of neck and back pain syndromes[7, 8)]. This causes a shortening of the posterior cervical and suboccipital muscles, lengthening and weakness of the anterior neck muscles, weakness of the scapular retractor muscles, and increased stress on the ligaments. A study showed that FHP reduces the average length of muscle fibers, which would contribute to an extensor torque about the atlanto-occipital joint, and it is possible that this shortening reduces the tension-generating capabilities of the muscles[7)].

Proper posture is considered to be a state of musculoskeletal balance that involves minimizing stresses and strains acting on the body[9)]. In clinical settings, assessment of posture is a common treatment approach for individuals with neck, shoulder, or back pain[10–12)]. In particular, head posture assessment is recommended as part of the examination of patients with neck pain to aid with diagnosis, determine treatment strategies and monitor the progress of the patient[10, 12–14)]. Major therapeutic tasks performed in physical therapy involve teaching the ideal posture to patients in order to prevent postural problems, such as FHP, and the correction of faulty postures. Many previous studies have investigated the assessment of FHP. However, clinical evaluation and head posture is generally based on the clinician's subjective visual impression. Besides, it is difficult to compare patients with each other and to quantify the improvements. Therefore, the aim of this study was to investigate the intra-rater and inter-rater reliabilities of the assessment of FHP using a digital camera to capture images of the sagittal plane of the upper body.

SUBJECTS AND METHODS

Forty-five participants (20 males, 25 females, mean±SD

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Table1. Intra-rater and inter-rater reliabilities of angles of FHP

	Measurement		ICC	SEM	95% CI
Intra	1st	2nd	0.91	0.16	0.32
	59.64±2.79	59.21±2.58			
Inter	Tester 1	Tester 2	0.75	0.13	0.26
	59.09±3.84	60.14±3.06			

Mean ± SD
FHP: Forward head posture; ICC: Intraclass correlation coefficient
SEM: Standard error of measurement; CI: Confidence interval

age of 21.33±1.7 years) were recruited. The subject inclusion criteria were as follows: free of neck and back pain for at least 12 months, and no shoulder or cervical spine pathologies, or rheumatoid or neurological condition. All subjects understood the purpose of this study and provided their written informed consent prior to participation. The study protocol was approved by Institutional Review Board of a university hospital. The raters were 2 physical therapists recruited for this study. The eligibility criteria were having at least 3 years of clinical experience and a self-report that they routinely assessed FHP by observation in their clinical practice.

Images of each subject were captured using a digital camera to capture the sagittal plane profile of the upper body in the sitting position. Rand markers were placed over the right tragus (ear), acromion, and C7 spinous process. Forward shoulder angle was measured as the angle from the vertical to a line connecting the C7 marker and the acromial marker. Forward head posture was defined as a forward a shoulder angle of 54° or less[13]. According to Norkin and White[15] rotation of the head was not assessed because the angular measurements of head rotation are easily distorted by trunk rotation. Measurement of the forward shoulder angle was made of blind of the qualitative assessment of FHP made by the raters and the digitisation procedure was found to be highly reliable (ICCs _0.98). A standard distance of 3 m, between the camera and the subjects, was used.

Two raters using identical procedures rated the same set of 3 images. Raters were given standardized written instructions, the answer sheet and an envelope. In the instructions sheet, raters were asked to rate FHP and extension from the lateral image using the position asked by physical therapists. This scale was chosen because it was found to be used in clinical practice to characterize FHP[14]. Raters were told to view each image only once, to not change their assessment after moving to the next image, and not to give any information related to their assessment to the measurement of the forward shoulder angle. Raters were then shown the images and their assessments were recorded on the answer sheet. At the end of the assessment, they placed the answer sheet in the envelope, and gave it to the researcher. The envelope was kept sealed until assessments had been completed by the two raters. No external references were used to aid the assessment, because in a previous study physical therapists reported not to use external aids to inform the assessment of FHP by an observation[14].

Each rater repeated the assessment one week later. The order of appearance of the images was counterbalanced for assessment 1 and again for assessment 2 to minimize any learning or order effects.

Data analyses were performed using the PWAS statistical package 18.0 for Windows. Percentage of agreement, confidence intervals and the standard error of the mean were calculated for the intra- and inter-rater reliabilities. Angular values were grouped according to the rating attributed by all raters in the first assessment and analyzed using descriptive statistics. Angular values and the ratings attributed by each rater were also correlated using Kendall's Taub correlation coefficient[16].

RESULT

Participants' mean±SD height was 166.33±9.09 cm, weight was 58.38±10.86 kg and body mass index was 20.93±2.33 kg/m^2.

The results of intra-rater and inter-rater reliability are shown in Table 1. For the determination of intra-rater reliability, the first measurement had a mean±SD of 59.64±2.79°, and the second measurement had a mean±SD of 59.21±2.58° for forward head posture. The measurements of Tester 1 had a mean±SD of 59.09±3.84°, and the measurements of Tester 2 had a mean±SD of 60.14±3.06°. Intra-class correlation of intra-rater measurements indicated a very strong relationship (0.91), and intra-class correlation of inter-rater measurements showed a strong relationship (0.75) ($p<0.05$).

DISCUSSION

In the current study, we investigated the intra-rater and inter-rater reliabilities of the assessment of FHP. Photographic images were chosen to standardize FHP so that the same posture was assessed by all raters in the first and second assessments. Two physical therapists with five years of clinical experience participanted in this experiment investigating the intra- and inter-rater reliabilities of the assessment of FHP. The participating physical therapists were recruited from local outpatient clinics where their caseloads were mostly orthopedic. They were trained by one of the authors in the assessment of FHP. The results of this study demonstrated excellent intra-rater and inter-rater agreement levels for the assessment of FHP by the trained physical therapists. Therefore, the use of this method to assess FHP in clinical settings would improve the ability of the clinician to detect and quantify posture alterations and treatment effect.

Forward head posture or head posture assessment is suggested for the examination of patients with cervical joint pain to aid diagnosis, and decide treatment strategies for patients[1, 11, 14, 17]. Our results show that FHP measurement was strong reliability between intra-rater and inter-rater. Several methods of measuring forward head posture have been described in the literature. Nancy et al.[18] investigated intra-rater and inter-rater reliabilities of head posture measurement in non-pathologic individuals aged 18–34. They reported that all raters demonstrated significant correlations across the repeated measures, ICC=0.92–0.94, that suggesting that head posture measurement has high intra-rater reliability. In addition, several studies have indicated that head posture measurements utilizing a flexible tape and 30 cm combination square have intra-rater and inter-rater reliability ICCs ranging from 0.67 to 0.99[2, 7, 11].

Silva et al.[13] investigated whether the assessment of head posture as performed in clinical practice is reliable and valid. Ten physical therapists assessed forward head posture, head extension and side-flexion from images of 40 individuals with and without previous experience of neck pain, using a four-category scale. The assessment of head posture by observation and the four-category scale showed poor reliability and validity. They suggested that when comparing the ratings with angular measurements, some degree of overlap between adjacent categories and using assessment of visual, and goniometer can occur error and deviation. Even so, the extent of the overlap was too big and occurred not only between adjacent categories, suggesting that physical therapists rated similar head deviations as different, and different head posture deviations as similar[3, 5, 13]. Therefore, we consider that the reason our results were strong relationship in intra-rater and inter-rater reliabilities, because of the investigated sagittal plane.

Measurement error will occur in visual assessment or in goniometer measurement. The reliability and validity of using a computer for making measurements of images is well established. The results of our present study provide support for, computer use based on its reliability shown in forward head posture assessment. It may use the standardized clinical assessments in clinical implication.

In this study, we have shown that it is possible to assess FHP reliably. However, the method used relies on the assessor's judgment to identify a change in the posture and the accuracy of making angular measurements on a digital image. It is difficult to compare the results of most postural studies due to the lack of detailed quantitative data of postural assessment and the difficulty of reproducing certain assessment tools in the clinical setting. Further studies will be required to obtain detailed quantitative data for accurate measurement of the postural changes.

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