WEB PLOT DIGITIZER SOFTWARE: CAN IT BE USED TO MEASURE NECK POSTURE IN CLINICAL PRACTICE?

SURESH MANI[1,] SHOBHA SHARMA[2]*, DEVINDER KAUR AJIT SINGH[3]

[1]Department of Physiotherapy, Lovely Professional University, Phagwara – 144 402, Punjab, India. [2]Speech Science Program, Centre for Rehabilitation and Special Needs, Faculty of Health Sciences, Universiti Kebangsaan Malaysia, Kuala Lumpur, Malaysia. [3]Physiotherapy Program, Centre for Rehabilitation & Special Needs, Faculty of Health Sciences, Universiti Kebangsaan Malaysia, Kuala Lumpur, Malaysia.
Email: shobha.sharma@ukm.edu.my

ABSTRACT

Objective : The aim of this study was to examine the use of WPD software to evaluate FHP using digital photogrammetry method.

Method: A total of 15 adults with no history of neck pain for the past 6 months were recruited for the study. Using digital photogrammetry and sagittal head tilt, craniocervical and shoulder angles (SAs) were measured using a WPD, which is an open resource of web or Windows-based software.

Result: Fifteen participants aged 17–40 years (mean 24.7±6.3 years) were examined. Sagittal head tilt and craniocervical angles were 16.35°±8.33° and 47.43°±7.97°, respectively. SA was 52.28°±12.46°.

Conclusion: WPD may be used to evaluate FHP in the clinical settings. However, future research is required to determine the validity and reliability of WPD among patients with neck-related musculoskeletal disorders with a larger sample.

Key words: Forward neck posture, Quantitative, Photogrammetry, Software.

INTRODUCTION

Software may be useful to carry out quantitative forward head posture (FHP) assessment in clinical practice [1]. These software applications measure linear distances and angles in relation to the anatomic reference point on digital images to determine FHP [2]. The linear distance measurement method is difficult to implement into practice due to variation in the anatomical reference landmarks. On the other hand, angle-based FHP evaluation has been found to be a valid and reliable method using software application [2]. A variety of posture assessment software (Alcimage, software for posture assessment-SAPO, digital image-based postural assessment, all body 3D scan, Biotonix, corporis pro, Fish matrix, Fisiometer Posturogram, physical physio, physio easy, posture print, and posture assessment based on digital imaging [APPID]) have been reported in the literature for FHP evaluation [1]. However, most of these software are expensive and needs trained personnel to operate, and is not available in English language. Therefore, the aforementioned reasons could potentially discourage the use of quantitative FHP assessment and compromise the quality of service in regular clinical practice.

To provide more options, there is a need for alternative potential use of a software to determine FHP. For clinical use, this software should have essential qualities such as reliability, applicability, and functionality [3]. With advancement in information technology and its resources, there are software available on the Internet to measure angles on a digital image. Among this software, the Web plot digitizer (WPD) software is the multiprofessional web or window-based free software [4]. WPD software has been used to extract quantitative data from various types of plots and images. The "measure angle" and "distance measure" tools within the WPD software provide quantitative measurement of angles

and distance on a digital image. We utilized WPD software to measure the angles on a digital image [4] in our current study. The aim of this study was to examine the use the Plot Digitizer (WPD) software to evaluate FHP using digital photogrammetry method.

METHODS

Subjects
In this cross-sectional study, we used convenient sampling method with volunteers from a university teaching hospital. Fifteen participants aged 17–40 years (mean 24.7±6.3 years) without a history of neck pain during the previous 6 months were recruited. Before data collection, all participants were given an explanation about the study purpose, and their written informed consent was obtained. The University Ethical committee approved the study (NN-045-2015).

Digital photogrammetry
The measurement of neck posture angle using digital photogrammetry was carried out as per the previously established protocol [5]. A computer web camera (Logitech C310, HD, 1280x720) was mounted on a tripod and placed within a distance of 1.5 meters from the patient. The camera's height was adjusted at the level of participant's C7 spinous process. The examiner identified the cutaneous bony landmark and placed colored adhesive tape on the C7 spinous process and acromion process. A picture of the sagittal view of the right-sided neck with upper body was taken, and the following angles [5] were measured using the WPDS.

Web plot digitizer software
The Web plot digitizer is a multiprofessional open resource image processing application that can be freely downloaded from the

following link http://arohatgi.info/WebPlotDigitizer/index.html. The key advantage of the web version is that it does not require installation on the user's own hard drive. The angle measuring function is a mathematical algorithm which transforms the three dots of an image onto the cartesian coordinates axis and auto-calculates the angles [4]. The image was uploaded onto the software, and the following angles were measured using the "angles measure" function as previously reported [5].

Sagittal head tilt angle (SHA) represents the upper cervical extension and flexion. An increase in SHA angle indicates the extension of the upper cervical spine. Craniocervical angle (CCA) represents the forward translation of the head. The decrease in the CCA angle indicates more forward neck posture [5]. The shoulder angle (SA) represents forward movement of the shoulder in reference to the C7 spine. A decrease in SH angle indicates forward movements of the shoulder [5].

RESULTS

A total of 15 participants without neck pain (5 men and 10 women) with mean and standard height deviation of 1.60±0.09 meters; the weight of 57±16.4 kg, and body mass index (BMI) 22.5±8.50 kg/m² were involved. Table 1 demonstrates the details of SHA, CCA, and SA angles. Fig. 1 displays the values of each angle measured using the WPD software.

DISCUSSION

In this study, we used WPD software to determine quantitative FHP. Despite digital photogrammetry using a valid and reliable method for determining the objective FHP, the use of this technique in clinical practice is still lacking [6]. In particular, posture evaluation software is a key component that allows clinicians to measure angles accurately. There are a number of software applications reported in the literature. Most of them are not practical for use universally because of its cost
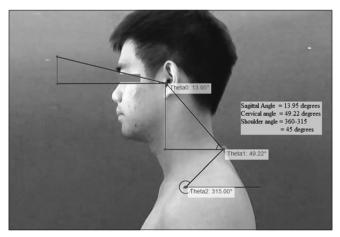

Fig. 1: The sagittal head tilt, craniocervical, and shoulder angles measured using the web plot digitizer software

Table 1: The details of demographic, mean and standard deviation of sagittal head tilt, craniocervical, and SAs among participants without neck pain

Outcome measure	Men (n=5)	Women (n=15)	Total (n=15)	Normal value
Age	24.80±7.92	24.70±5.83	24.73±6.31	
BMI	22.02±3.00	22.67±10.23	22.45±8.48	
SHA	17.10±12.79	15.98±5.91	16.35±8.33	17.20±5.70
CCA	47.60±6.66	47.34±8.89	47.43±7.97	50.00±5.20
SH	47.67±6.03	54.59±14.41	52.28±12.46	51.40±8.50

SHA: Sagittal head tilt angle, CCA: Craniocervical angle, SA: Shoulder angle

and requirement for trained personnels to operate and non-availability in English versions. Our current study demonstrated preliminary evidence of WPD software in measuring FHP among healthy population as a reference in the future for its use in other populations with neck impairments.

CCA is the most common angle to measure FHP and cervical kyphosis. It was reported in a previous study that normal CCA was 53.2°–56.8° which was measured using Adobe Acrobat software [7]. In our current study, the mean CCA was 47.43°±7.97°, which is less than normal ranges (53.2°–56.8°)(ref). In the study by Salahzadeh *et al.*, it was found that based on digital photogrammetry, 50% of their study participants had a slight FHP, and this was classified as "normal FHP" with subjective classification [7]. This indicates that even people without a history of neck pain demonstrate a slight FHP. The overlap of subjective visual classification of neck posture against the angle measurement suggests high sensitivity of the angle based on FHP evaluation [6]. SHA indicates upper cervical extension. Chansirinukor *et al.* reported the mean value of SHA as 16.3° [8]. However, in our present study, the mean value of SHA was 16.41°±7.86° among healthy participants. This SHA among healthy individuals corresponds to previous reported values [8]. Furthermore, the SA provides an indication of shoulder position in references to C7 cervical spinous process. Patients having protracted shoulders were suggested if the SA angle was <52° [5]. In our present study, the mean SA was 52.28°±12.46°, which is in line with this previous study report.

In our current study, WPD software was employed in healthy adults without neck impairments without comparison, and this is considered as the first limitation of our study. Second, WPD software reliability in evaluating FHP using digital photogrammetry is not known. Therefore, future studies should examine the reliability of WPD software through the digital photogrammetry method among a population with neck pain.

CONCLUSION

Since the use of a software application is part of the component in quantitative FHP assessment using photogrammetry, the WPD may be useful to evaluate FHP in patients with neck pain. This may provide options for quantitative neck posture assessment in the current clinical practice.

CONFLICTS OF INTEREST

There are no conflicts of interest.

REFERENCES

1. Camelo EM, Douglas MU, Uchoa SJ, Brasileiro DV, Maia MR. Use of softwares for posture assessment: Integrative review. Coluna Columna 2015;14:230-5.
2. Silva AG, Punt TD, Sharples P, Vilas-Boas JP, Johnson MI. Head posture assessment for patients with neck pain: Is it useful? Int J Ther Rehabil 2009;16:43-53.
3. Nam SH, Son SM, Kwon JW, Lee NK. The Intra-and Inter-rater reliabilities of the forward head posture assessment of normal healthy subjects. J Phys Ther Sci 2013;25:737-9.
4. Rohatgi A. Web Plot Digitizer; 2015. Available from: http://www.arohatgi.info/WebPlotDigitizer. [Last accessed on 2015 Sep 18].
5. Ruivo RM, Pedro PC, Carita AI, Pezarat-Correia P, Carita AI. Cervical and shoulder postural assessment of adolescents between 15 and 17 years old and association with upper quadrant pain. Braz J Phys Ther 2014;18:364-71.
6. Gadotti IC, Biasotto-Gonzalez DA. Sensitivity of clinical assessments of sagittal head posture. J Eval Clin Pract 2010;16:141-4.
7. Salahzadeh Z, Maroufi N, Ahmadi A, Behtash H, Razmjoo A. Assessment of forward head posture in females: Observational and photogrammetry methods. J Back Musculoskelet Rehabil 2014;27:131-9.
8. Chansirinukor W, Wilson D, Grimmer K, Dansie B. Effects of backpacks on students: Measurement of cervical and shoulder posture. Aust J Physiother 2001;47:110-6.