Reliability of the Craniocervical Posture Assessment: Visual and Angular Measurements Using Photographs and Radiographs

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Abstract

Objective: The purposes of this study were to determine the intrarater and interrater reliability of the craniocervical posture in a sagittal view using quantitative measurements on photographs and radiographs and to determine the agreement of the visual assessment of posture between raters.

Methods: One photograph and 1 radiograph of the sagittal craniocervical posture were simultaneously taken from 39 healthy female subjects. Three angles were measured on the photographs and 10 angles on the radiographs of 22 subjects using Alcimage software (Alcimage; Uberlândia, MG, Brazil). Two repeated measurements were performed by 2 raters. The measurements were compared within and between raters to test the intrarater and interrater reliability, respectively. Intraclass correlation coefficient and SEM were used. κ Agreement was calculated for the visual assessment of 39 subjects using photographs and radiographs between 2 raters.

Results: Good to excellent intrarater and interrater intraclass correlation coefficient values were found on both photographs and radiographs. Interrater SEM was large and clinically significant for cervical lordosis photogrammetry and for 1 angle measuring cervical lordosis on radiographs. Interrater κ agreement for the visual assessment using photographs was poor ($\kappa = 0.37$).

Conclusion: The raters were reliable to measure angles in photographs and radiographs to quantify craniocervical posture with exception of 2 angles measuring lordosis of the cervical spine when compared between raters. The visual assessment of posture between raters was not reliable. (J Manipulative Physiol Ther 2013;36:619-625)

Key Indexing Terms: *Posture; Head; Neck; Reliability of Results; Photogrammetry; Radiography*

Commonly in clinical settings, a patient's posture is visually evaluated by a clinician using anatomical landmark references.[1] However, this measurement is often subjective and not quantifiable. Radiographs are considered the criterion standard for measuring cervical spine position.[2-4] Several clinical researchers use angles measured on radiographs to assess head posture.[5-9] However, radiation exposure limits the use of radiographs for screening posture in the clinical setting and in research studies.[4] In addition, radiographs are expensive.[10] Photogrammetry (measurements on photographs) to assess head and neck posture was thought to be a possible good clinical alternative to other methods such as the use of radiographs because it is noninvasive, less expensive, and it is more objective when compared with a visual assessment.[11] Nevertheless, more tests are needed to determine its reliability.

When assessing posture, the reliability of the postural measurements needs to be considered. A valid measure depends on the reliability of the measurement.[12] However, several studies investigating craniocervical posture using photogrammetry have failed to support their claims because of the lack of information regarding psychometric properties of the methods used.[13-16] The lack of reliability analysis has led readers to question the precision of the measurements described. Therefore, the objectives of this study were to test the intrarater and interrater reliability of the craniocervical posture in the sagittal view using quantitative measurements on photographs and radiographs and to determine the agreement between raters when using visual

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assessment of craniocervical posture using photographs and radiographs.

Methods

Subjects

A total of 39 healthy female subjects (age mean, 33 ± 8.03 years old; body mass index, 22.7 ± 2.6) participated. The included subjects presented with a normal craniocervical region defined as normal range of motion and absence of pain as evaluated by a physical therapist. Subjects were excluded if they presented with frequent pain in the craniocervical region, had a history of surgery or trauma to the head/neck, or a systemic disorder. To test the intrarater and interrater reliability of the measurements on photographs and radiographs, the first 22 subjects were included (age mean, 28 ± 4.37 years old; body mass index, 22.3 ± 3.24). The sample size was calculated using a sample size estimation table for reliability analysis.[17] Based on 2 repetitions, 0.05 α and 0.80 power, a minimal sample size of 21 subjects was needed. To test the interrater reliability of the visual evaluation of posture, all 39 subjects were included (as well as the 22 previous subjects). This study was approved by the Radiation Safety Committee and by the Ethics Board from the University of Alberta.

Procedure

First, the subjects had their craniocervical region evaluated to determine if they were eligible for the study. A physical assessment of the head/neck region included a medical history, palpation, and range of motion evaluation. If eligible, a lateral radiograph and a photograph of the craniocervical region were taken simultaneously from each subject's left side at the Glen Sather Clinic from the University of Alberta. At the clinic, the subject's skin overlying the spinous process of C2, C4, and C7 were located by palpation of the cervical spine and marked with a hypoallergenic pen by the first investigator. Reference markers made of light metal were placed on the marks and on the tragus of the ear (left side) with a double-side adhesive tape.

Standardization of Posture

Subjects were asked to stand relaxed during the procedure. The position of the head was standardized using the self-balance position,[18] asking the subjects to perform a large amplitude of cervical flexion and extension, gradually decreasing to rest in the most comfortably position keeping the gaze horizontal. This position was ensured by a reference mark placed on the wall at the same level of the subject's eyes. The level of the subject's eyes was measured using a laser level that was held on the lateral canthus of the subject's eye. The laser pointer was projected on the wall in front of the subjects indicating where the marker needed to be placed. Feedback from the subjects was also used to ensure that the point was centered and in a habitual/comfortable position.

Fig 1. *Illustration for the photogrammetry: CVA in gray, CIA in black, CA (cervical angle) in white.*

Radiographic Procedure

The distance between the x-ray tube and film was 72 in (1.8 m). The area of the images included the nasion-sella line to the seventh cervical vertebra including the body of the vertebrae and spinous processes. The cephalostat (instrument to position the head during a radiographic examination) was not used in this study so as not to influence the posture.[19] A metal plumb line was positioned beside the subject for a vertical reference.

Analysis

Codes were placed on top of the subject identification on the radiographs by an independent person using a random digits table,[20] so the investigator was blinded to each subject. The radiographs were scanned (Epson-1680; Epson, Willowdale, Canada) and transferred to the computer. The photographs and digitalized radiographs were analyzed using Alcimage software (Alcimage; Uberlândia, MG, Brazil). Measurements of the craniocervical posture in subjects with different dental occlusions using this software have demonstrated excellent intrarater reliability (intraclass correlation coefficient [ICC], 0.99).[21] Ten angles were measured on the radiographs, and 3 angles, on the photographs.

The following angles were measured on the photographs according to each aspect of posture (Fig 1):

1. The position of the head in relation to the cervical spine: Craniovertebral angle (CVA) represented by the angle formed by a line connecting tragus of the ear and spinous process of C7 with the horizontal line[13,14,22-24];