Concordance and Reliability of Photogrammetric Protocols for Measuring the Cervical Lordosis Angle: A Systematic Review of the Literature

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Abstract

Objective: The aim of this study was to examine and interpret the concordance, accuracy, and reliability of photogrammetric protocols available in the literature for evaluating cervical lordosis in an adult population aged 18 to 59 years.

Methods: A systematic search of 6 electronic databases (MEDLINE via PubMed, LILACS, CINAHL, Scopus, ScienceDirect, and Web of Science) located studies that assessed the reliability and/or concordance and/or accuracy of photogrammetric protocols for evaluating cervical lordosis, compared with radiography. Articles published through April 2016 were selected. Two independent reviewers used a critical appraisal tool (QUADAS and QAREL) to assess the quality of the selected studies.

Results: Two studies were included in the review and had high levels of reliability (intraclass correlation coefficient: 0.974-0.98). Only 1 study assessed the concordance between the methods, which was calculated using Pearson's correlation coefficient. To date, the accuracy of photogrammetry has not been investigated thoroughly.

Conclusion: We encountered no study in the literature that investigated the accuracy of photogrammetry in diagnosing hyperlordosis of cervical spine. However, both current studies report high levels of intra- and interrater reliability. To increase the level of evidence of photogrammetry in the evaluation of cervical lordosis, it is necessary to conduct further studies using a larger sample to increase the external validity of the findings. (J Manipulative Physiol Ther 2018;41:71-80)

Key Indexing Terms: *Photogrammetry; Radiography; Reproducibility of Results; Spine*

Introduction

The cervical spine is the upper region of the vertebral column, which appears concave posteriorly when viewed in the sagittal plane and for which the normal curvature angles range between 20° and 40°.[1-4] Knowledge of this angle is useful for diagnostic purposes, for monitoring postural change and the effectiveness of therapeutic interventions in postural alignment.[5,6]

Among the techniques used to measure cervical lordosis, radiography is the most accurate and is considered the gold standard for facilitating visualization of the position of the vertebrae, without the influence of soft tissues.[7,8] The 2 most common methods of measuring the cervical curvature angle via radiography described in the literature are the Cobb and posterior tangent methods. The Cobb angle in the neck is measured through the intersection of lines drawn over the center of the upper cervical vertebral body (C1) and the inferior endplate of the lowest cervical vertebra (C7). The posterior tangent method, on the other hand, considers the angle formed by a line drawn through the apex of the odontoid process and the extremity of the posterior-inferior region of the body of the C4 vertebra, with a line that crosses the posterior inferior region of the C4 to C7 bodies (Fig 1).[1,9]

Although the described methods are the most accurate for diagnosing postural changes, their repeated use is limited because continuous and repeated exposure to radiation is harmful to human health and should therefore be avoided when monitoring the development of postural changes.[10,11] Thus, for the quantitative assessment of cervical lordosis, it is necessary to develop accurate,

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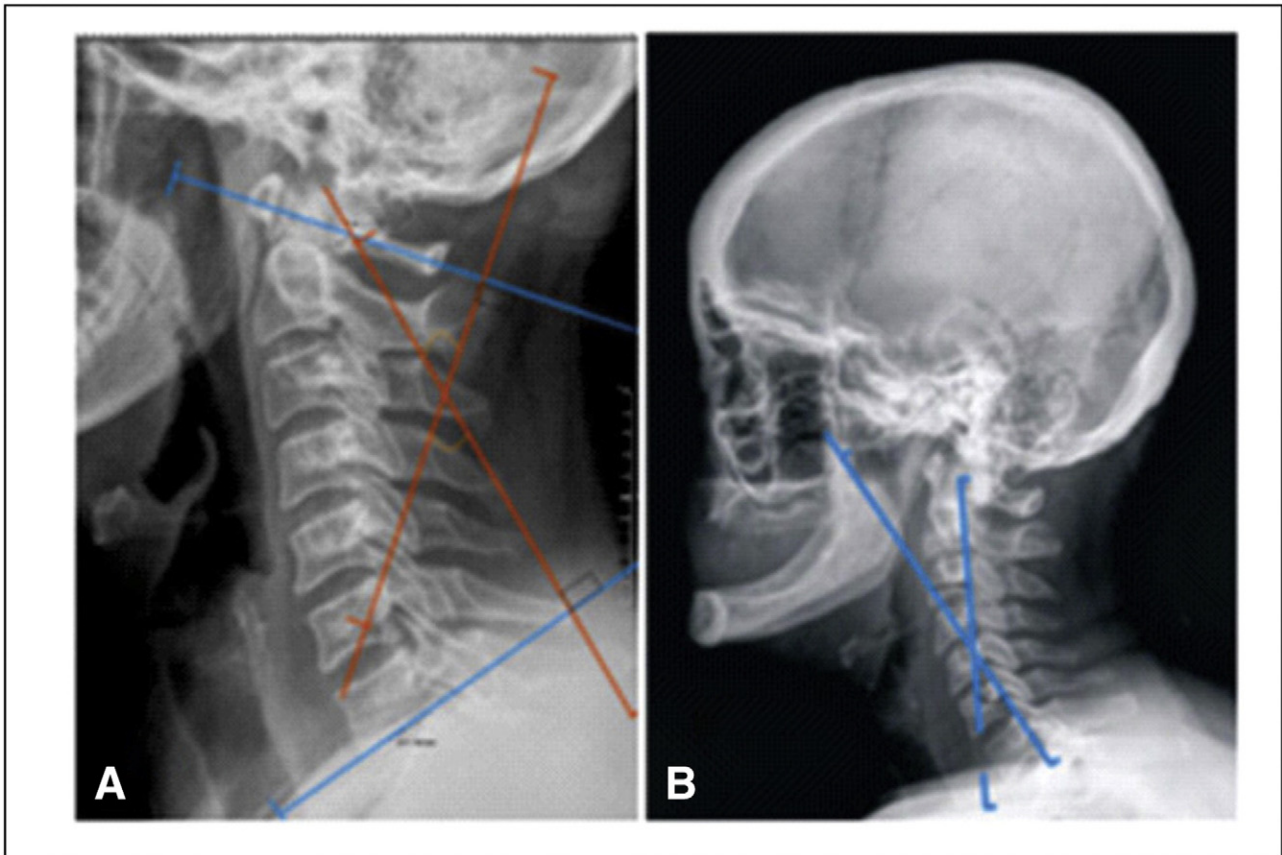
Fig 1. *Cervical lordosis angle. A, Cobb angle method. B, Posterior tangent method.*

noninvasive techniques that provide valid information when compared with the gold standard.[12]

Among the available noninvasive techniques, photogrammetry associated with the use of software such as CorelDraw and ALCimagem is an outstanding method for tracing and measuring angles and horizontal and vertical distances.[3-6] This method may be considered superior to other non-invasive methods because of the low costs involved, its easy transportation and photo-interpretation, and its capacity to measure small postural changes and register the monitoring of progression, stabilization, or reduction of postural asymmetries in adults over time.[4,13] However, to date, there has been no consensus on the best protocol for photogrammetric evaluation and no reports regarding its sensitivity and specificity in diagnosing cervical hyperlordosis and rectification.[14]

Therefore, it is important to summarize the evidence regarding the accuracy, concordance, and reliability of computerized photogrammetry protocols for measuring the angle of cervical lordosis. This information could contribute to a more specific clinical assessment, which, in turn, would assist in monitoring the development of patients with cervical pain and posture disorders, as well as verifying the effectiveness of interventions over time, and hence create

normal parameters of cervical lordosis. Late diagnosis and rehabilitation may result in cervical pain, postural changes, or severe deformities, affecting physical appearance, cardiopulmonary function, and psychological well-being.[8-10]

The objective of this literature review was to investigate whether computerized photogrammetry protocols that measure the angles of cervical concavity are in concordance with radiography, are able to accurately diagnose cervical hyperlordosis and rectification in adults aged between 18 and 59 years, and have good intra- and interrater reliability. This review may also provide guidance on planning future studies that assess cervical lordosis, considering the shortcomings of articles published in the literature.

METHODS

This systematic review was structured using the guidelines from Preferred Reporting Items for Systematic Reviews and Meta-Analysis.

Search Strategy in the Databases

The survey was conducted through April 2016 in MEDLINE via PubMed, LILACS, CINAHL, Scopus,