Journal of Bodywork & Movement Therapies (2015) 19, 717–721

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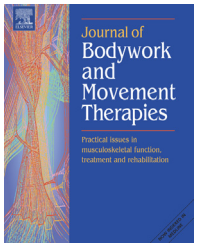

PREVENTION & REHABILITATION: ORIGINAL RESEARCH

Correlation between neck slope angle and deep cervical flexor muscle thickness in healthy participants

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Received 24 January 2015; received in revised form 18 March 2015; accepted 2 April 2015

KEYWORDS
Ultrasound imaging;
Neck;
Deep cervical flexor muscles;
Muscle thickness

Abstract The purpose of this study was to clarify the correlation between neck slope angle and deep cervical flexor muscle thickness in healthy subjects.

Forty-two healthy male (20.7 ± 2.6 years old) participated in this study. Neck slope angle was measured in a relaxed sitting posture. The deep cervical flexor muscle thickness was measured in a relaxed supine posture. The correlations between neck slope angle and normalized muscle thickness relative to body mass index were determined using Pearson's correlation coefficient.

There was a moderate positive correlation between neck slope angle and normalized muscle thickness ($r = 0.414$, $P = 0.006$). The result demonstrated that participants with lower neck slope angles had smaller muscle thicknesses of the deep cervical flexor muscles.

It appears that the deep cervical flexor muscle thickness might be associated with neck slope angle in a relaxed sitting posture.

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http://dx.doi.org/10.1016/j.jbmt.2015.04.001
1360-8592/

Introduction

The ideal posture is defined as a state of musculoskeletal balance that minimizes the strain on the body. One objective method of assessing neck posture is to measure neck slope angle between a horizontal line through the spinous process of C7 and a line from the spinous process of C7 through the tragus of the ear (Figure 1) (Kuo et al., 2009; Watson and Trott, 1993). The time spent in daily living with the head translated forward has been increasing while working on a computer in sitting positions, and a correlation between neck slope angle and disability has been shown in patients with neck disorders (Yip et al., 2008). Therefore, postural correction and re-education should be considered as an integral part of prevention and management of patients with neck pain (Yip et al., 2008).

Recent studies have suggested that specific deep cervical flexor muscle-strengthening exercises can be effective in adjusting neck slope angle (Falla et al., 2007; Lee et al., 2013; Gupta et al., 2013). The deep cervical flexor muscles, longus capitis and longus colli, are important for the control of cervical lordosis and maintenance of cervical spine posture (Mayoux-Benhamou et al., 1994). Mayoux-Benhamou et al. (1994) showed that the cross sectional area (CSA) of longus colli is negatively related to cervical lordosis in healthy individuals. However, little is known about the relationship between neck slope angle and the size of the deep cervical flexor muscles. We hypothesize that lower neck slope angle is related to a decrease in the size of the deep cervical flexor muscles. Recent studies have reported on the validity and reliability of quantitative measurements of the deep cervical flexor muscle thickness by ultrasound imaging (Cagnie et al., 2009; Javanshir et al., 2011a, 2011b; Ishida et al., 2015). Previous studies reported that the ultrasound reliability in the measurement of the CSA, anterior posterior dimension, and lateral dimension of the longus colli (Cagnie et al., 2009; Javanshir et al., 2011a). However, to clearly image the whole muscular fasciae of the deep cervical flexor muscle is difficult because of the acoustic shadow of the trachea, which causes the medial boundary of the longus colli to appear insufficiently clear on ultrasound imaging (Javanshir et al., 2011b). Therefore, we have developed a new ultrasound parameter for the evaluation of the deep cervical flexor muscle thickness (Ishida et al., 2015) (Figure 2). The purpose of this study was to clarify the correlation between neck slope angle and deep cervical flexor muscle thickness in healthy subjects. The aim of this work was to provide basic information on therapeutic exercises for the neck.

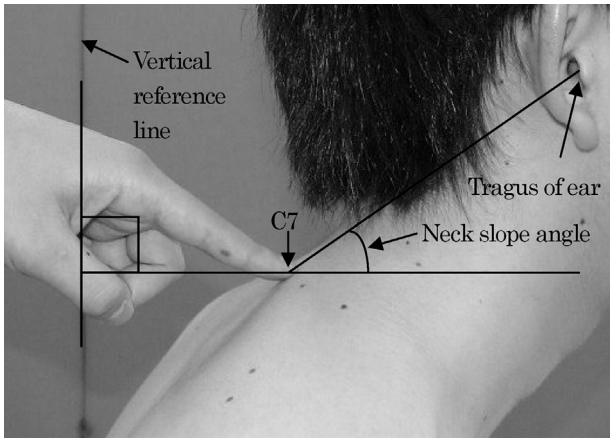

Figure 1 Neck slope angle. Neck slope angle was measured as the angle between lines drawn from the tragus of the ear to the spinous process of C7 and one subtended to the horizontal.

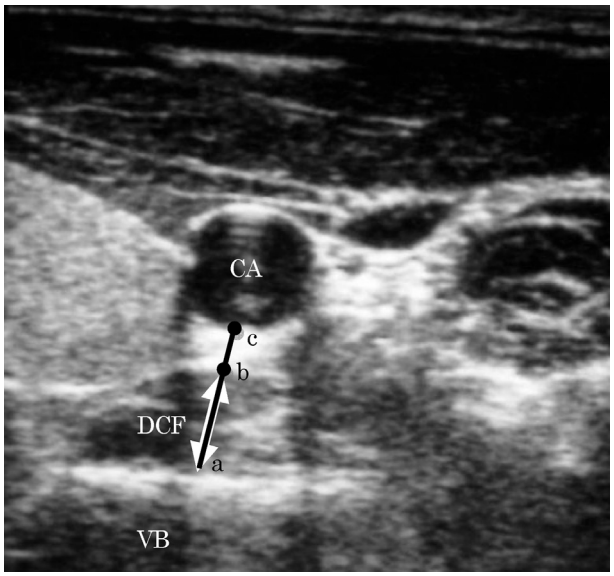

Figure 2 Ultrasound imaging of the deep cervical flexor muscles (DCF). The diagonal dimension of the DCF (ab) was measured as the distance between the anterolateral boundary (muscular fasciae of the DCF) and posteromedial boundary (the vertebral body) (VB) in the line that passes through the nearest 2 points between the carotid artery (CA) (c) and the muscular fasciae of the DCF (b).

Methods

Participants

Participants were recruited by using advertisements from physiotherapy students from Kawasaki University of Medical Welfare. Participants were excluded if they had suffered neck pain over the previous year, had a history of orthopaedic disorders affecting the neck or neurological disorders, or if they had specifically trained their neck muscles over the previous six months. Forty-two male volunteers participated in the study and their mean ± standard deviation (minimum—maximum) age, height, weight, and body mass index (BMI) were 20.7 ± 2.6 (18—32) years, 170.7 ± 5.4 (159—185) cm, 62.9 ± 11.8 (44—105) kg, and 21.5 ± 3.7 (17.4—36.8) kg/m^2, respectively. The protocol for this study was approved by the Ethics Committee at the Kawasaki University of Medical Welfare, and participants provided their informed written consent prior to participation.