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Original article

Reliability and validity of goniometric and photographic measurements of clavicular tilt angle☆

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ABSTRACT

The aims of the present study were to assess the reliability of clavicular tilt angle measurement using goniometric and photographic measurements and to test the validity of the measurement by comparing the results with radiographic findings (gold standard).

Clavicular tilt angles were measured in 18 healthy subjects (36 clavicles) using goniometric, photographic, and radiographic measurement. Repeated measurements using goniometric and photographic measurements were made in two test sessions conducted on different days by two examiners to assess inter-rater and intra-rater reliability of the two methods. Radiographic measurement was taken once, and the correlation between the radiographic findings and those of the indirect methods was calculated to test the validity of the goniometric and photographic measurement of clavicular tilt angle.

No significant difference in clavicular tilt angle measurement was found between test sessions. The reliability of goniometric measurement (inter-rater intraclass correlation coefficients (ICC) = 0.85 (95% CI = 0.72–0.92) – 0.87 (95% CI = 0.77–0.87); intra-rater ICC = 0.80 (95% CI = 0.64–0.89)) and photographic measurement (inter-rater ICC = 0.89 (95% CI = 0.80–0.94) – 0.95 (95% CI = 0.91–0.98); intra-rater ICC = 0.84 (95% CI = 0.71–0.92) – 0.84 (95% CI = 0.69–0.91)) were excellent. The goniometric and photographic measurements of clavicular tilt angle were highly correlated with the radiographic findings (r = 0.83, 0.78, respectively). Goniometric and photographic measurements of clavicular tilt angle obtained by raters in this study may be considered reliable, and data obtained using the goniometric and photographic measurements are representative of radiographic findings of clavicular tilt angle.

1. Introduction

An alteration in the clavicular tilt angle may indicate a change in muscle length and joint alignment that precludes optimal motion (Saltmann, 2002). A change in the clavicular tilt angle associated with abnormal scapular alignment may affect the muscle length of the deltoid, upper trapezius, and subclavius muscles, causing a biomechanical alteration and possibly shoulder joint pain (Novak and Mackinnon, 1997; Kendall et al., 2003). The clavicular tilt angle can be used as an indicator to determine the presence of a depressed or downward-rotated scapula. For these reasons, assessment of the clavicular tilt angle is important for upper extremity evaluation.

Previous studies incorporated measurement of the clavicular tilt angle to investigate shoulder muscle imbalance (Kuldo et al., 2002; Akel et al., 2008; Uzlmcügil et al., 2012), but to our knowledge, no study has elucidated the reliability and validity of clavicular tilt angle measurement. Ludewig et al. (2004) concluded that three-dimensional assessment of clavicular motion using electromagnetic motion analysis was a reliable measurement in an asymptomatic and shoulder pathology group. Several tools for assessing postural or bony alignment are available for clinical and experimental use. These include a simple photographic technique (Charsirimukor et al., 2001), goniometers (Riddle et al., 1987), inclinometers (deWinter et al., 2004), various computer-assisted methods (McClure et al., 2004; Ishikawa et al., 2009), and radiographic findings (Akel et al., 2008; Uzlmcügil et al., 2012).

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