



Short communication

Tracking the scapula using the scapula locator with and without feedback from pressure-sensors: A comparative study

A.F. Shaheen^a, C.M. Alexander^b, A.M.J. Bull^{a,*}^a Department of Bioengineering, Imperial College London, Royal School of Mines, South Kensington Campus, London SW7 2AZ, UK^b Department of Physiotherapy, Imperial College Healthcare NHS Trust, Charing Cross Hospital, London W6 8RF, UK

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ABSTRACT

Background: The scapula locator method has associated intra-observer and inter-observer errors caused by the dependency on the observer to locate the scapular landmarks. The potential effect of the pressures applied by the observer on the measured scapular kinematics when this method is used has also been overlooked so far. The aim of this study was to investigate the effect of using feedback on the pressures applied on the scapula using the locator on the intra-observer and inter-observer reliabilities of the method as well as on the kinematics obtained using this method.

Methods: Three observers tracked the scapular motion of the dominant shoulder of each subject using the locator with no reference to pressure-feedback for three trials of bilateral elevation in the scapular plane and using the locator with pressure-feedback for three other trials. Variations between the measurements obtained were used to calculate the intra-observer errors and variations between the measurements obtained by the three observers for the same subject were used to calculate inter-observer errors. Repeated-measures ANOVA tests were used to look at differences between the two methods in terms of intra-observer and inter-observer errors and scapular kinematics.

Findings: Using pressure-feedback reduced the intra-observer errors but had no effect on the inter-observer errors. Different scapular kinematics was measured using the two methods.

Interpretations: Pressure-feedback improves the reliability of the scapula locator method. Differences in the scapular kinematics suggest that unregulated pressures have an effect on the physiological scapular motion.

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1. Introduction

The thick layer of soft-tissue covering the scapula makes it difficult to determine the bone's position during motion. This has led to the development of a number of scapular measurement techniques. Non-invasive techniques include the use of an acromion sensor, but it has been shown to have high errors above 100° of elevation (Karduna et al., 2001; van Andel et al., 2009). Other non-ionising imaging techniques have been recently used; however they restrict subjects to certain orientations and are yet to be validated (Hill et al., 2007). The scapula locator method was developed to reduce the problem of soft-tissue deformation and is commonly used in clinical studies (Kontaxis and Johnson, 2008; Price et al., 2001). However, the manual handling of the locator by an observer means that the method is associated with intra-observer and inter-observer errors (de Groot, 1997; Meskers et al., 1998).

Furthermore, there is no information on the effect of external forces applied on the scapula on the shoulder kinematics. Therefore the effect of the unregulated pressures applied using the locator on the scapular movement is unknown. Recently a new scapula locator has been developed, which allows the observer to maintain regulated range of low pressures on the landmarks using feedback from pressure-sensors whilst tracking the scapular movement (Shaheen, 2010).

The aim of this study is to investigate whether feedback on the pressures applied on the contact points with the scapular landmarks improves the intra-observer and inter-observer reliabilities of the scapula locator and whether the unregulated pressures applied using the locator have an effect on the measured kinematics.

2. Methods

2.1. Instrumentation

An optical motion system (Vicon, Oxford) was used to track markers attached to the humerus, thorax and scapula locator. The locator has three pressure sensors (Interlink Electronics, Camarillo) attached to the tips of the probes in contact with

* Corresponding author.

E-mail address: a.bull@imperial.ac.uk (A.M.J. Bull).