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Original article

Study of the trapezius muscle region pressure pain threshold and latency time in young people with and without depressed scapula

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ABSTRACT

The scapula is stabilized in or moved to a certain position to coordinate shoulder function and achieve shoulder and arm movement during the athletic and daily activities. An alteration in the scapular position both at rest and during arm movements is commonly associated with shoulder injury or dysfunction. The purpose of this study was to assess the influence of the depressed scapular position using pressure pain threshold (PPT) and delayed muscle activation of the upper and middle trapezius muscles. The study included 20 subjects who were divided into normal shoulder ($n = 12$) and depressed shoulder ($n = 8$) group. PPT was measured in a relaxed position. Muscle activity was recorded using surface electromyography and by calculating each shrug's muscle latency time (MLT). The results revealed that the healthy young subjects with depressed scapular position had significantly lower PPT levels than those with normal scapular position both in the upper and middle trapezius muscle ($P < 0.05$). MLT of the upper trapezius was significantly delayed in both sides during the shoulder shrugs ($P < 0.05$).

1. Introduction

Complex scapular, shoulder and arm movements are required to allow the glenohumeral joint achieve the positions needed in daily and athletic activities. These movements are maintained by tissue support and muscle control that stabilizes the scapula, shoulder, and arm in a certain position to accomplish motion (Tsai et al., 2003; Di Giacomo et al., 2008), and the scapula plays an important role in the shoulder and arm function (Di Giacomo et al., 2008; Kibler et al., 2009).

Several studies have illustrated the relationship between the scapular position and synergic muscle pathology (Swift and Nichols, 1984; Sahrmann, 2002; Kendall et al., 2005; Azevedo et al., 2008), whereas in recent studies, researchers have explored healthy subjects with depressed scapular position (Azevedo et al., 2008; Andrade et al., 2008).

The influence of depressed scapular position on tissue sensitivity of the upper trapezius muscles and the relationship between the scapular vertical position and active cervical rotation range-of-motion were both investigated in previous studies. The relationship between abnormal scapular kinematics and associated muscle functions was however, not addressed by them. The paired trapezius muscles form a diamond shape that extend through the midline from the occiput superiorly to T12 inferiorly, and posteriorly transverse throughout the spinal length of the scapula (Martini et al., 2009). The scapula lies against the posterior thoracic cage overlying the second to the seventh rib with the medial border parallel to and about three fingers breadth from the middle of the back and anteriorly rotated 30° to the frontal plane (Kesson and Atkins, 2005; Saladin, 2007; Paterson, 2009). The three angles of the scapula are the superior, inferior, and lateral angles (Saladin, 2007). The anterior surface is the subscapular fossa, and the posterior surface includes the spine, supraspinous fossa, and infraspinous fossa (Saladin, 2007). The scapula is held in place by numerous muscles attached to the spine and fossae (Saladin, 2007;

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Martini et al., 2009). The scapula and trapezius are inter-related because an abnormal scapular position may affect the function and operation of the whole trapezius (Paterson, 2009). Therefore, it is necessary to refine our knowledge on the relationship between scapular dysfunction and muscle activation during the shoulder movement period. Understanding the scapular and trapezius function in shoulder related pathologies are therefore extremely important for providing potential guidelines for interventions aimed at improving the shoulder motion.

Surface electromyography (SEMG) is the use of electronic devices to measure the muscle energy, analyze the data and display the results (Cram and Criswell, 2011). Compared with needle electromyography, SEMG is a clinically easier, noninvasive, and less sensitive technique (Pullman et al., 2000). Therefore, this technique is commonly performed (Phadke et al., 2009) for the trapezius muscles, which are the largest and most superficial scapulothoracic muscles of the thoracic spine (Di Giacomo et al., 2008). The motor system organizes and controls the skeletal muscle activation during movement, posture, and the musculoskeletal aspect of behavior and expression (Lederman, 2010). These motor control changes may include a delayed activation or deactivation of the muscles, which fails to be recruited on time (Phadke et al., 2009). In addition, muscle latency time (MLT) is delayed when the shoulder muscles are abnormally positioned during arm activities (Cools et al., 2002; Moraes et al., 2008).

Pressure algometry has been widely used to assess sensitivity of human tissues to mechanical stimuli (Blikstad and Gemmell, 2008; Finocchietti et al., 2011) and has excellent reproducibility (Fabio Antonaci, 1998). The effects of scapular position on the mechanical hypersensitivity of the upper trapezius muscles was recently investigated (Azevedo et al., 2008). These experiments revealed that subjects with depressed scapular position had lower upper trapezius PPT levels than those with normal scapular position (Azevedo et al., 2008). However, to the best of our knowledge, no study to date has investigated the influence of depressed scapular position on the other regions of the trapezius muscles.

The purpose of this study was to investigate the influence of scapular position on both the mechanical properties and temporal recruitment pattern of the upper and middle trapezius muscles – relationship between the scapular position and trapezius muscles using pressure pain threshold (PPT) and muscle latency time (MLT) – in young healthy subjects.

In present study, it is supposed that healthy subjects with depressed scapular position might have lower PPT levels in upper and middle trapezius muscle position and delayed muscle activation timing while compared with subjects with normal scapular position during the scapular motion.

2. Methods

2.1. Definition of scapular location

In this study, we established a discrimination procedure to differentiate the scapular location and reduce artificial deviations, as shown in Fig. 1a and b. For the posture assessment, subjects were directed to sit on a backless chair in a relaxed position with their hands placed on their lap (Gemmell and Bagust, 2009). The scapular location was then confirmed (Lewis et al., 2002), and adhesive round stickers (radius, $r = \sqrt{1cm^2/\pi}$) were attached to both the right and left shoulders, which involved the superior angle of the scapula (SAS), lateral acromial border (LAB), and spinous process of the second thoracic vertebra (SP2). The location of SP2 and LAB and SAS was determined using previously reported methods followed by Muscolino (2008) and Tixa (2008). Next, we erected a tripod head and shelved a camera and laser level meter behind these subjects. The laser height was centered on SP2 level. In addition, the tables were reconfirmed for no disproportion, and images were recorded using a countdown trigger. A depressed scapular (DSC) group placement was determined as a vertical SAS position and LAB below the laser horizontal line. Neutral scapular (NSC) group position was determined when the two SASs and T2 can form a straight line which is perpendicular to the spine (Fig. 1a and b).

2.2. Hardware design

2.2.1. Pressure threshold algometer

The electronic pressure algometer (FDX 25, WAGNER) was used to assess the muscle pressure pain sensation, which consisted of a

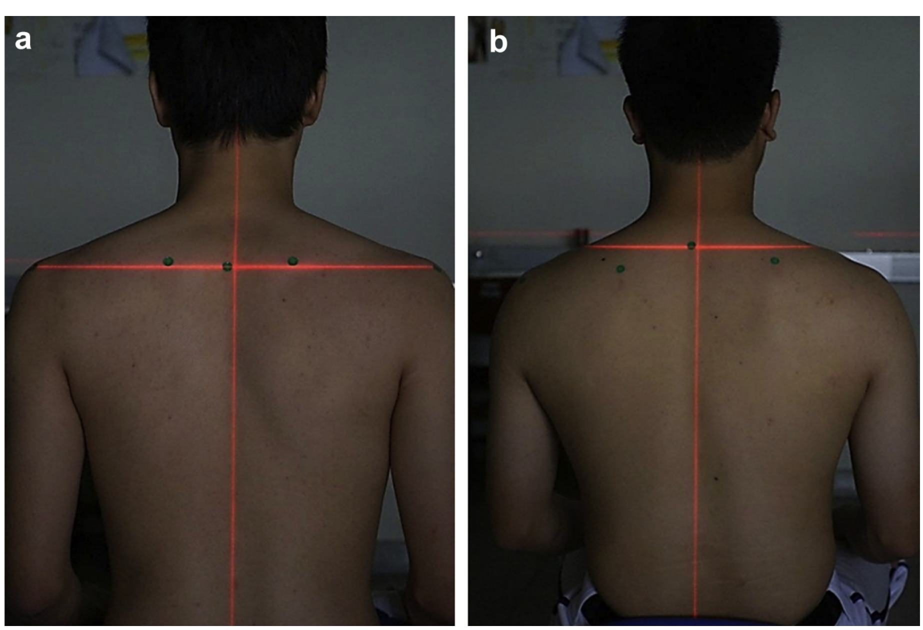

Fig. 1. The scapular position: (a) Superior angle of the scapula on the same level as the T2 spinous process, (b) Superior angle of the scapula on the lower level as the T2 spinous process.