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Original article

The effect of a scapular postural correction strategy on trapezius activity in patients with neck pain

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ABSTRACT

Extensive computer use amongst office workers has lead to an increase in work-related neck pain. Aberrant activity within the three portions of the trapezius muscle and associated changes in scapular posture have been identified as potential contributing factors. This study compared the activity (surface electromyography) of the three portions of the trapezius in healthy controls ($n = 20$) to a neck pain group with poor scapular posture ($n = 18$) during the performance of a functional typing task. A scapular postural correction strategy was used to correct scapular orientation in the neck pain group and electromyographic recordings were repeated. During the typing task, the neck pain group generated greater activity in the middle trapezius (MT) ($p = 0.02$) and less activity in the lower trapezius (LT) ($p = 0.03$) than the control group. Following correction of the scapula, activity recorded by the neck pain group was similar to the control group for the middle and lower portions ($p = 0.09$; $p = 0.91$). These findings indicate that a scapular postural correction exercise may be effective in altering the distribution of activity in the trapezius to better reflect that displayed by healthy individuals.

1. Introduction

Complaints of work-related neck pain are becoming increasingly prevalent, especially amongst intensive computer users (Cook et al., 2000; Korhonen et al., 2003; Silanpaa et al., 2003; Cagnie et al., 2007). A recent study conducted by Cagnie et al. (2007) found that over a twelve-month period, 45.5% of 512 office workers reported neck pain. Studies investigating neck pain associated with static sitting postures have identified altered posture and muscle recruitment patterns in the cervicobrachial region as potential contributing factors (Nederhand et al., 2000; Falla et al., 2004; Szeto et al., 2005).

Individuals with neck pain may display altered postural behaviours when performing prolonged sitting tasks, such as during computer use. Szeto et al. (2002) found that office workers with neck pain tended to drift in and out of scapular protraction more than asymptomatic office workers. These changes were associated with altered behaviour in the upper trapezius (UT) muscle and were linked to the severity of neck pain experienced. That is, those with higher levels of discomfort displayed a more aberrant pattern of trapezius muscle behaviour compared to those with mild/no symptoms (Szeto et al., 2005). These findings are consistent with other observations of altered trapezius muscle behaviour in patients with neck pain disorders (Nederhand et al., 2000; Falla et al., 2004; Thorn et al., 2007).

Clinical theory contends that aberrant scapular posture and any associated changes in axioscapular muscle activity may contribute to, or exacerbate painful neck disorders by adversely affecting mechanical stresses on pain sensitive cervicobrachial structures (Behrsin and Maguire, 1986). Consequently, scapular postural correction strategies have been advocated as part of the intervention for patients with neck pain who display an alteration in scapular orientation (Jull et al., 2008; Mottram et al., 2009). It is hypothesised that correcting scapular orientation will positively influence the activity of the axioscapular muscles such as the trapezius muscles. Certainly it has been shown that scapular posture can be accurately trained in healthy controls and that all three portions of the trapezius muscle are active in maintaining scapular orientation (Mottram et al., 2009). However, the effect of scapular correction exercises on trapezius muscle behaviour in the neck pain population remains unknown. In particular it is unknown if a scapular postural correction exercise would normalise the myoelectric activity in the different portions of the trapezius in individuals with neck pain.

The aims of the study were twofold. Firstly, to establish if there was a difference in trapezius muscle behaviour in people with neck pain who display aberrant scapular posture compared to healthy controls during a functional typing task. The second aim was to

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evaluate the effect of a scapular postural correction strategy on trapezius muscle behaviour in the neck pain participants when the typing task was repeated. Specifically we aimed to determine whether correcting the scapular orientation in the people with neck pain would alter the activity levels in the three portions of the trapezius muscle to better reflect those displayed by the healthy controls.

2. Methods

2.1. Participants

Thirty-eight volunteers participated in the study including 20 pain free controls and 18 individuals with neck pain. Participants included both males and females in an age range of 18–48 years and were recruited from the university and general community. Sample size was based on our previous study utilizing similar data collection methodology and patient populations to identify differences in trapezius muscle activity between control and neck pain populations (alpha = 0.05, power = 0.92) (Johnston et al., 2008b).

Participants were included into the control group if they were asymptomatic and were without a history of neck pain or neck trauma. The control participants were also required to display 'good' scapular posture and control to allow comparison with the neck pain group who were selected on the basis of an aberrant scapular posture. It was hypothesised that controls who displayed good posture would ultimately display ideal trapezius muscle behaviour. 'Good' scapular posture was defined as the mid-position between all available ranges of scapular motion – upward/downward rotation, medial/lateral rotation, anterior/posterior tipping and protraction/retraction (Ludewig et al., 2009; Mottram et al., 2009). This was assessed by the primary investigator who visually analysed the position of the acromion in the sagittal plane both at rest and during upper limb active movement. The side that most accurately displayed scapular mid-position was chosen as the test side.

Participants were included into the neck pain group if they scored 15% or greater on the Neck Disability Index (NDI) – a minimal score to reflect the presence of at least a mild neck pain disorder (Vernon, 2008), had a history of neck pain of greater than three months duration over a 12-month period and demonstrated poor scapular posture on the symptomatic side of their neck in a relaxed standing posture. The resting position was visually assessed by the primary investigator with a poor posture being considered a deviation from the mid-position between all available ranges of scapular motion – upward/downward rotation, medial/lateral rotation, anterior/posterior tipping and protraction/retraction. Poor scapular posture was included as a criterion to ensure that there was clinical justification to perform a scapula correction strategy in the second part of the study. If both sides displayed poor scapular posture, the most symptomatic side was chosen as the test side. Participants were excluded if they had a history of neck surgery; chronic neck pain resulting from a traumatic incident (for example: motor vehicle crash); a medical diagnosis of fibromyalgia, cervical radiculopathy, carpal tunnel syndrome, systemic illness or a connective tissue disorder, any neurological signs or shoulder pathology.

Written informed consent was obtained from all participants. The Institutional Medical Research Ethics Committee granted ethical approval for this study.

2.2. Baseline measures

The participants with neck pain completed theNDI (Vernon and Mior, 1991) and completed a visual analogue scale (VAS) for pain. This scale was anchored as 0 = no pain and 10 = the worst pain imaginable. Age and body mass index (BMI) were also recorded for each participant to ensure that any confounding could be controlled. Table 1 provides the participant demographics for both the neck pain and control groups.

2.3. Electromyography

Surface electromyography (EMG) was used to obtain myoelectric signals from the three portions of the trapezius muscle. Pairs of electrodes were placed unilaterally at the mid-position between the C6 spinous process and the lateral acromion, on the anterior border of the muscle bulk, for the UT muscle (Mercer, 2002). Electrodes for the middle portion of the trapezius (MT) were placed adjacent to the spinous process of T2. For the LT, electrodes were positioned along the line between T5 and the acromion (Johnson and Pandyan, 2005). The electrodes used were 10 mm adhesive Ag/AgCl (Myotronics-Noromed, Inc.) surface electrodes (MT and LT) and 20 mm surface electrodes (Myotronics-Noromed, Inc.) (UT). A centre-to-centre inter-electrode distance of 20 mm was employed. The reference electrode was placed over the upper thoracic spine. Prior to attachment of the electrodes, the participants' skin was prepared by cleaning the area with an abrasive gel and alcohol (Hermens et al., 2000). The area was shaved if necessary. A 6-channel EMG was used (NeuroLog, Digitimer Ltd., England). EMG signals were amplified (gain, 1000), passed through a 10–500 Hz band-width filter and sampled at 1000 Hz. Data were sampled with Spike software (Cambridge Electronics Design, UK) and converted into a format suitable for signal processing with Matlab 7 software (The Math Works, Inc).

2.4. Procedure

Participants sat in a comfortable position at a standard office workstation in an adjustable chair without arm supports. They were instructed to make individual changes for their comfort (McLean, 2005). Resting EMG was recorded for 10 s prior to commencement of the task with the participant sitting in a relaxed position with their hands resting on the keyboard. They were then asked to type continuously at their normal pace for 5 min. A copy-typing program, Bruce's Typing Tutor was used to display the text. Errors could be corrected using the backspace key.

The participants with neck pain undertook the second stage of the study. These participants were instructed in a postural correction exercise. The primary investigator taught the participant to assume a neutral lumbar spine and to correct the scapular position using the necessary cues to position the scapula on the chest wall in the mid-position between all directions of scapular motion specific for that participant. This involved various instructions as pertinent to the scapular orientation of the individual subject – for example for downwardly rotated scapula instructions included "gently lift

Table 1
Descriptive statistics for the neck pain and control groups.

	Neck pain ($n = 18$) [mean (S.D)]	Control ($n = 20$) [mean (S.D)]
Age (years)	27.2 (6.9)	24.8 (6.6)
Gender Male	7	7
Female	11	14
BMI (kg/m^2)	22.4 (3.7)	23.3 (2.4)
NDI (0–100)	20.2 (5.5)	–
VAS (0–10) on testing day	2.0 (2.0)	–
Duration of neck pain (yrs)	5.5 (4.8)	–