Available online at www.sciencedirect.com
ScienceDirect
Manual Therapy 13 (2008) 507–512
MANUAL THERAPY
www.elsevier.com/math

Original article

Training the cervical muscles with prescribed motor tasks does not change muscle activation during a functional activity

Deborah Falla[a,b,*], Gwendolen Jull[a], Paul Hodges[a]

[a]Division of Physiotherapy, The University of Queensland, Brisbane, Australia
[b]Department of Health Science and Technology, Center for Sensory-Motor Interaction (SMI), Aalborg University, Denmark

Received 12 March 2007; received in revised form 31 May 2007; accepted 3 July 2007

Abstract

Both low-load and high-load training of the cervical muscles have been shown to reduce neck pain and change parameters of muscle function directly related to the exercise performed. The purpose of this study was to investigate whether either training regime changes muscle activation during a functional task which is known to be affected in people with neck pain and is not directly related to either exercise protocol. Fifty-eight female patients with chronic neck pain were randomised into one of two 6-week exercise intervention groups: an endurance-strength training regime for the cervical flexor muscles or low-load training of the cranio-cervical flexor muscles. The primary outcome was a change in electromyographic (EMG) amplitude of the sternocleidomastoid (SCM) muscle during a functional, repetitive upper limb task. At the 7th week follow-up assessment both intervention groups demonstrated a reduction in their average intensity of pain ($P<0.05$). However, neither training group demonstrated a change in SCM EMG amplitude during the functional task ($P>0.05$). The results demonstrate that training the cervical muscles with a prescribed motor task may not automatically result in improved muscle activation during a functional activity, despite a reduction in neck pain.

Keywords: Neck pain; Electromyography; Exercise; Sternocleidomastoid

1. Introduction

Therapeutic exercise has demonstrated efficacy in reducing pain and perceived disability in people with neck pain disorders (Bronfort et al., 2001; Jull et al., 2002; Ylinen et al., 2003; Chiu et al., 2005). In addition to a change in symptoms, therapeutic exercise has been shown to improve cervical muscle function (Bronfort et al., 2001; Ylinen et al., 2003; Chiu et al., 2005; Jull et al., 2005; Falla et al., 2006).

In recent studies (Jull et al., 2005; Falla et al., 2006, 2007), we compared the effect of low-load cranio-cervical flexion training and higher load endurance/strength training of the cervical flexor muscles on various aspects of cervical muscle function in people with chronic neck pain. Following 6 weeks of training the cranio-cervical flexor muscles, patients with neck pain displayed a significant increase in deep cervical flexor electromyographic (EMG) amplitude during a test of cranio-cervical flexion (Jull et al., 2005). This was associated with decreased sternocleidomastoid (SCM) EMG amplitude and increased cranio-cervical flexion range of motion (Jull et al., 2005), indicating improved performance on the test (Jull et al., 1999). In contrast, patients who participated in 6 weeks of cervical flexor strength training did not demonstrate a similar improvement (Jull et al., 2005). This difference was identified despite a comparable reduction in pain and perceived disability between the two exercise groups. In a further study (Falla et al., 2006) it was identified that

*Corresponding author. Department of Health Science and Technology, Center for Sensory-Motor Interaction (SMI), Aalborg University, Fredrik Bajers Vej 7D-3, DK-9220 Aalborg, Denmark. Tel.: +45 96 35 74 59; fax: +45 98 15 40 08.
E-mail address: deborahf@hst.aau.dk (D. Falla).

1356-689X/$ - see front matter © 2007 Elsevier Ltd. All rights reserved.
doi:10.1016/j.math.2007.07.001

6 weeks of cervical flexor endurance-strength training results in reduced myoelectric manifestations of SCM muscle fatigue and increased cervical flexion strength in people with chronic neck pain. Conversely, no effect was identified for the patients who received the lower load cranio-cervical flexion training. Thus, improvement in muscle function following training was task specific and directly related to the exercise protocol (Jull et al., 2005; Falla et al., 2006). It is unknown whether either training protocol for the cervical muscles would influence muscle activation during functional activities which are unrelated to the specific exercise protocol.

The purpose of this study was to investigate whether specific training with low-load cranio-cervical flexion exercise or higher load endurance-strength exercise would change muscle activation during a functional task which is known to be altered in people with neck pain and is not directly related to the exercise protocol. This study forms part of a series of experiments to investigate the mechanisms of efficacy of cervical muscle retraining. The effects of both exercise regimes on pain and disability have been reported in our previous work (Falla et al., 2006).

2. Methods

2.1. Subjects

Fifty-eight female participants with a history of chronic neck pain of greater than 3-month duration participated in this study (Table 1). Subjects were recruited by advertisements in the local press. Subjects were excluded if they scored >15 (out of a possible 50) on the Neck Disability Index (NDI) (Vernon and Mior, 1991) to minimise the limitations that higher levels of pain and disability might have on performance of the endurance-strength exercise regime. They were excluded if they had undergone cervical spine surgery, presented with any neurological signs or had participated in a neck exercise programme in the past 12 months. An examination of the cervical spine was performed to confirm the presence of palpable cervical joint tenderness (Jull et al., 1988). The subjects included in this study also formed part of another study (Falla et al., 2006). Ethical approval for the study was granted by the Institutional Medical Research Ethics Committee and all procedures were conducted according to the Declaration of Helsinki.

Table 1
Baseline characteristics for patients with chronic neck pain randomised into a cranio-cervical flexion exercise intervention or endurance-strength exercise intervention

	Cranio-cervical flexion exercise intervention ($n=28$)	Endurance-strength exercise intervention ($n=29$)
Age	37.7±10.1	38.1±10.7
Length of neck pain history (years)	7.6±6.0	8.3±7.0
Onset (insidious, whiplash) % whiplash	17.8	13.8
Average neck pain intensity (0–10)	3.5±2.0	4.7±2.0
Neck Disability Index (0–50)	9.8±3.3	10.1±3.0

Mean and standard deviation are shown.

2.2. Exercise interventions

Patients with chronic neck pain were randomised by an independent body using a computer-generated sequence of numbers into two exercise groups: endurance-strength training of the cervical flexor muscles and cranio-cervical flexion training. Exercise regimes were conducted over a 6-week period and patients in each group received personal instruction and supervision by an experienced physiotherapist once per week for the duration of the trial. None of the exercise sessions were longer than 30 min. Subjects were asked not to receive any other form of specific intervention for their neck; however, medication was not withheld from any participant. All subjects were supplied with an exercise diary and requested to practice their respective regime twice per day for the duration of the trial. The exercise occupied a period of no longer than 10–20 min per day. The exercises were to be performed without any provocation of neck pain.

2.3. Cervical flexor endurance-strength training

The endurance-strength training regime consisted of a progressive resistance exercise programme for the neck flexors. Exercises were performed in supine, with the head supported in a comfortable resting position. Patients were instructed to lift their head so that cervical flexion was performed maintaining a neutral upper cervical spine. Patients were to slowly move the head and neck through full range of cervical flexion motion as possible without causing discomfort or reproduction of their symptoms. The exercise regime involved two stages. The first stage was of 2-week duration and the second was of 4-week duration as recommended for initiation of a weight programme in previously untrained individuals (McArdle et al., 1996). In stage 1, the subjects performed 12–15 repetitions with a weight that they could lift 12 times on the first training session (12 repetitions maximum) and progressed to 15 repetitions and maintained this level for the remainder of the 2-week period. In stage 2, the subjects performed three sets of 15 repetitions of the initial 12 repetitions maximum load once per day. One-minute rest intervals