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Original article

Pain education combined with neck- and aerobic training is more effective at relieving chronic neck pain than pain education alone – A preliminary randomized controlled trial☆

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ABSTRACT

Objective: To evaluate the effect of training and pain education vs pain education alone, on neck pain, neck muscle activity and postural sway in patients with chronic neck pain.
Methods: Twenty women with chronic neck pain were randomized to receive pain education and specific training (neck–shoulder exercises, balance and aerobic training) (INV), or pain education alone (CTRL). Effect on neck pain, function and Global Perceived Effect (GPE) were measured. Surface electromyography (EMG) was recorded from neck flexor and extensor muscles during performance of the Cranio-Cervical Flexion Test (CCFT) and three postural control tests (two-legged: eyes open and closed, one-legged: eyes open). Sway parameters were calculated.
Results: Fifteen participants (CTRL: eight; INV: seven) completed the study. Per protocol analyses showed a larger pain reduction ($p = 0.002$) for the INV group with tendencies for increased GPE ($p = 0.06$), reduced sternocleidomastoid activity during the CCFT ($p = 0.09$), reduced sway length ($p = 0.09$), and increased neck extensor activity ($p = 0.02$) during sway compared to the CTRL group.
Conclusion: Pain education and specific training reduce neck pain more than pain education alone in patients with chronic neck pain. These results provide encouragement for a larger clinical trial to corroborate these observations.

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1. Introduction

Musculoskeletal disorders are the most common reason for long-term illness, and neck pain is the most frequent with a 1-year prevalence of around 37% (range: 17–75%) (Fejer et al., 2006).

Some of these patients have chronic neck pain (with insidious onset or with whiplash associated disorders) and they present with a variety of signs and symptoms ranging from deficits in neuromuscular control (D.L. Falla et al., 2004; Jull et al., 2004; Peolsson and Kjellman, 2007; D. Falla et al., 2011; Lindstrom et al., 2011; O'Leary et al., 2011; Schomacher et al., 2012), proprioceptive and balance deficits (Treleaven et al., 2005; Cheng et al., 2010; Roijezon et al., 2011; Juul-Kristensen et al., 2013), and disturbances in central pain processing (Van Oosterwijck et al., 2013). Deficits in neuromuscular function include reduced neck muscle strength (Lindstrom et al., 2011) and endurance (Peolsson and Kjellman, 2007), reduced activity of the deep cervical flexors (D.L. Falla et al., 2004; D. Falla et al., 2011) and extensors (O'Leary et al., 2011; Schomacher et al., 2012), and augmented activity of the superficial flexor muscles (Falla et al., 2004; Jull et al., 2004). Proprioceptive and balance deficits include increased joint position error during neck repositioning tasks (Cheng et al., 2010), increased postural sway during balance tasks (Treleaven et al., 2005; Roijezon et al., 2011; Juul-Kristensen et al., 2013), and visual disturbances (Treleaven and Takasaki, 2014). The consequences of such sensorimotor disturbances are reduced general health, quality of life and physical activity.

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A recent systematic review (Damgaard et al., 2013) concluded that multimodal physiotherapy, including exercises targeting muscle strength and endurance (Jull et al., 2007), or general aerobic training (Stewart et al., 2007), combined with pain education compared with pain education alone, can be effective in reducing pain and neck disability in whiplash patients. However, the optimum exercise type, level, progression mode, duration and frequency of aerobic training for chronic neck pain patients remain unknown (Damgaard et al., 2013).

Recent studies showed that specific training of the deep neck muscles increased the activity of the deep muscles, reduced activity of the superficial muscles, and reduced neck pain and disability in people with chronic neck pain (Jull et al., 2009; Falla et al., 2011, 2013). The neck extensors are as well impaired in chronic neck pain patients (Fejer et al., 2006; Falla et al., 2011). Whether the specific training of combined neck exercises for the neck flexors, as well as the extensors, also may have any effects on the neck extensors, and reducing or just maintaining the superficial neck extensor muscle activity, has never been studied. The effect of combined exercises on the function of the cervical extensors in the CCFT has not been studied earlier.

Studies of the effects of single treatment modalities, such as education in enhancing patients' understanding of chronic pain mechanisms and the development of appropriate coping and behavioral strategies, combined with aerobic training, have shown positive effects in people with chronic pain, including neck pain (Wicksell et al., 2008). Moreover, specific training of the deep neck muscles leads to increased activity of the deep muscles, reduced activity of the superficial muscles, and reduced neck pain and disability in people with chronic neck pain (Jull et al., 2009; Falla et al., 2011, 2013). Further, aerobic training reduced pain in people with widespread pain and fibromyalgia (Mannerkorpi and Henriksson, 2007). However, it is unknown whether the combined effect of such targeted specific neck muscle training combined with general aerobic training, as an add-on to education in pain management, has a superior effect on neck pain compared with only giving education in pain to patients with chronic neck pain (Hansen et al., 2011).

The aim of this study was to conduct a preliminary investigation to evaluate the effect of specific neck/shoulder and general aerobic training combined with pain education vs pain education alone, on pain, function, neck muscle activity and postural sway in women with chronic neck pain.

2. Methods

2.1. Design

The study was a single blind randomized controlled trial with a parallel group design. For practical reasons, EMG measurements could not be performed on the entire population (200 patients) enrolled in the original RCT (randomised controlled trial). Thus a small study was performed in addition to the large RCT, where the subjects performed additional measurements of EMG, which forms the sample of the current study. The aim of the original RCT was to test the self-reported general physical function, in addition to neck function, pain, disability and quality of life in patients with chronic neck pain with and without injury compared with a matched control group, measured at baseline and 4 and 12 months after baseline (Hansen et al., 2011). EMG data are not measured in the original study. Patients were informed not to disclose their group allocation. Recruitment period was November 2012–May 2013, and the study was approved by the Institutional Medical Research Ethics Committee (S-20100069), and procedures followed the Declaration of Helsinki. Outcomes included patient reported outcomes (pain, function), postural sway, and electromyography (EMG) of the cervical flexors and extensors before (baseline) and after the intervention/control period (follow-up).

2.2. Procedures

2.2.1. Randomization procedures

Patients were randomized after baseline measurements to receive either pain education or training (INV) or pain education alone (CTRL), stratified according to symptom origin (Insidious Neck Pain, INP; Whiplash Associated Disorder, WAD). The randomization sequence was created using SAS (SAS 9.2 TS level 1 M0) statistical software and the allocation sequence were concealed from the researcher enrolling and assessing participants in sequentially numbered, opaque, sealed and stapled envelopes. After revealing the content of the envelope, both patients and physiotherapists were aware of the allocation and the corresponding treatment. Outcome assessors and data analysts were however kept blinded.

Participants were asked not to seek other treatments during the study.

2.2.2. Study population

Subjects were recruited by local advertisements.

2.2.3. Inclusion criteria

Neck pain for at least six months, reduced physical neck function (Neck Disability Index score, NDI, >10/50), pain primarily in the neck region, completed radiological examinations, ability to read and understand Danish and willingness to participate in the exercise program.

2.2.4. Exclusion criteria

Neuropathies/radiculopathies (clinically tested by positive Spurling, cervical traction and brachial plexus tests), engagement in experimental medical treatment, being in unstable social and/or working situation, pregnancy, known fractures, severe depression according to the Beck Depression Index (BDI score > 29/63), or other known coexisting medical conditions possibly restricting participation in the training program.

Fifty-one patients with chronic neck pain were assessed for eligibility. Thirty-one did not meet the inclusion criteria, thus 20 women, either INP (Treleaven et al., 2005) or WAD (Schomacher et al., 2012) were included (Fig. 1).

Written informed consent was provided before participation.

2.3. Outcomes

2.3.1. Demographics and subjective reports

Baseline demographics were obtained including age, weight, Body Mass Index, and duration of symptoms. Outcome measures included pain (least intense, average during the past two days, and current, on a Numeric Rating Scale; 0–10), neck-related disability (NDI; 0–50), self-reported health (Short Form 36; 0–100), and pain medication use. At follow-up Global Perceived Effect (GPE; −5 to +5) was further registered.

2.3.2. Electromyography

Surface EMG was registered at baseline and after the intervention/control period from the following three muscles on the most painful side (dominant side if bilaterally affected): Anterior scalene (AS), Sternocleidomastoid (SCM) and Neck extensors (NE) (Falla et al., 2002; Juul-Kristensen et al., 2006). Bipolar electrodes (Ag/AgCl, Ambu Blue Sensor, N-00-S/25, Ballerup, Denmark) were

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