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Original article

Respiratory weakness in patients with chronic neck pain

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ABSTRACT

Respiratory muscle strength is one parameter that is currently proposed to be affected in patients with chronic neck pain. This study was aimed at examining whether patients with chronic neck pain have reduced respiratory strength and with which neck pain problems their respiratory strength is associated. In this controlled cross-sectional study, 45 patients with chronic neck pain and 45 healthy well-matched controls were recruited. Respiratory muscle strength was assessed through maximal mouth pressures. The subjects were additionally assessed for their pain intensity and disability, neck muscle strength, endurance of deep neck flexors, neck range of movement, forward head posture and psychological states. Paired *t*-tests showed that patients with chronic neck pain have reduced Maximal Inspiratory (MIP) ($r = 0.35$) and Maximal Expiratory Pressures (MEP) ($r = 0.39$) ($P < 0.05$). Neck muscle strength ($r > 0.5$), kinesiophobia ($r < -0.3$) and catastrophizing ($r < -0.3$) were significantly associated with maximal mouth pressures ($P < 0.05$), whereas MEP was additionally negatively correlated with neck pain and disability ($r < -0.3$, $P < 0.05$). Neck muscle strength was the only predictor that remained as significant into the prediction models of MIP and MEP. It can be concluded that patients with chronic neck pain present weakness of their respiratory muscles. This weakness seems to be a result of the impaired global and local muscle system of neck pain patients, and psychological states also appear to have an additional contribution. Clinicians are advised to consider the respiratory system of patients with chronic neck pain during their usual assessment and appropriately address their treatment.

1. Introduction

Chronic neck pain is one of the most frequent musculoskeletal complaints and can lead to adaptive musculoskeletal and motor control changes in cervical region and related structures (Falla and Farina, 2008; Jull et al., 2008a). Although neck pain is predominantly considered and treated in clinical practice as a neuromusculoskeletal problem, the close anatomical connection of the cervical region with the thoracic spine in parallel with their musculoskeletal and neural connection have led some researchers to believe that neck pain may lead to associated changes in thoracic spine and rib cage and consequential changes in pulmonary function (Kapreli et al., 2008).

Cervical spine studies have shown that muscle strength and endurance (Chiu and Lo, 2002; Harris et al., 2005), cervical mobility (Rix and Bagust, 2001), head posture (Lau et al., 2009) and cervical proprioception (Cheng et al., 2010) are all affected in patients with chronic neck pain, whereas abnormal psychological states namely anxiety, depression, kinesiophobia and catastrophizing may also be present (Leino and Magni, 1993; Hill et al., 2007; Mantyselka et al., 2010). It has been recently theorized that all of these parameters can have their own unique contribution for the development of respiratory dysfunction or abnormalities in patients with chronic neck pain (Kapreli et al., 2008) and preliminarily supported by a previous pilot study (Kapreli et al., 2009). Changes in cervical mobility, head posture and dysfunction of local and global muscle system are believed that lead to changes in force–length curves, muscle imbalances and segmental instability (Gossman et al., 1982; Comerford and Mottram, 2001; Key et al., 2008) potentially affecting the function of thoracic cage and rib cage mechanics (Kapreli et al., 2008). This dysfunction might be more apparent during inspiration as the common muscles of cervical region and respiration (sternocleidomastoid, scaleni and trapezius) are all inspiratory in function (Palastanga et al., 2002). Furthermore, the existence of psychological factors such as kinesiophobia might also lead to movement avoidance further contributing to the dysfunction of cervical muscles and consequentially to the potential changes in rib cage mechanics (Kapreli et al., 2008).

These changes in rib cage biomechanics could lead to associated changes of respiratory muscles altering their force–length curves

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and force production abilities (Gossman et al., 1982; Kapreli et al., 2008). Piloting findings support this belief as patients with chronic neck pain have been found to present reduction in their maximal mouth pressures (Kapreli et al., 2009). However, existent literature provides no other known evidence about the strength of respiratory muscles in patients with chronic neck pain. Furthermore, the association of respiratory strength with the common musculoskeletal and psychological manifestations of patients with chronic neck pain remains completely unexplored. The examination of the respiratory strength and its association with the known manifestations of neck pain could lead to a better understanding of the changes occurring due to neck pain and to improvement of the usual assessment and treatment provided in these patients. Given the above, this study was aimed at investigating the possible existence of respiratory weakness in chronic neck pain patients and the correlations among the aforementioned factors.

The hypotheses of the present study were that:

H_0: Patients with chronic neck pain have no different maximal inspiratory and expiratory pressures from healthy controls.

and

H_0: Maximal inspiratory and expiratory pressures of patients with chronic neck pain are not correlated with their musculoskeletal (forward head posture, strength of neck muscles, endurance of deep neck flexors, cervical range of movement, pain intensity) and psychological (anxiety, depression, catastrophizing, kinesiophobia) manifestations.

2. Methods

2.1. Sample

In this cross-sectional study, 45 patients with chronic neck pain and 45 healthy gender-, age-, height- and weight-matched controls were conveniently recruited. Patients were included if they had pain for at least 6 months with pain complaints at least once a week and were between 18 and 65 year old. Patients with spinal or chest surgeries, smoking history, traumatic cervical injuries, acute or chronic neuromusculoskeletal pain in any other non-related body area, serious obesity (Body Mass Index (BMI) >40), clinical abnormalities of the thoracic cage or vertebral column, occupational industrial exposures, serious comorbidities (neurological, neuromuscular, cardiorespiratory, psychiatric and musculoskeletal disorders), diabetes mellitus and/or malignancies were excluded from the study.

The same eligibility criteria were applied for the healthy control group. Healthy controls were individually matched with neck pain patients in terms of gender, age (±5 years), height (±10 cm) and weight (±10%). All the participants were assessed at the cardiorespiratory lab of the Physiotherapy Department, Technological Educational Institute (TEI) of Lamia, Lamia, Greece during the 2009–2010 years. All the subjects had to sign an informed consent before their participation to this study. The study was approved by the Ethics Committee of the Department of Physiotherapy, School of Health and Caring Professions, TEI Lamia, Greece and the University of Manchester Ethics Committee.

2.2. Procedure

Maximal Inspiratory Pressure (MIP) and Maximal Expiratory Pressure (MEP) were assessed in a randomized order from a standing position (Fig. 1) with a portable mouth pressure meter (microRPM, Micro Medical Limited, Rochester, Kent, England) and the accompanying PUMA PC software [Intraclass Correlation Coefficient (ICC) = 0.81–0.83, Standard Error of Measurement (SEM) = 12–14 cmH_2O] (Dimitriadis et al., 2011). After a short demonstration of the procedure, the volunteers were asked to perform 5 maximal inspiratory and expiratory efforts with an at least 30-s interval between the trials. During the measurement of maximal mouth pressures the participants were asked to close firmly their mouth around the flanged mouthpiece. A noseclip was fitted to avoid any air leak. A small piece of tape was placed on the mouth pressure meter monitor in order for the participants to be blind to their performance. The MEP was assessed after asking the participants to inhale as much as possible and then to exhale maximally against the resistance of the gauge for at least 1 s. The MIP was recorded after asking the participants to expire as much as possible and then to inhale maximally against the resistance of the gauge for at least 1 s. The participants were verbally encouraged throughout the procedure for maximal performance. The best of the inspiratory and expiratory efforts were recorded as the MIP and MEP respectively.

Fig. 1. Positioning for assessing maximal mouth pressures.

The maximal voluntary isometric strength of neck flexors and extensors was assessed in a randomized order from the Neutral Head Position (NHP) after a short warm-up period. The measurements were performed in standing position with a custom-made