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Immediate effects of thoracic spinal mobilisation on erector spinae muscle activity and pain in patients with thoracic spine pain: a preliminary randomised controlled trial

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Abstract

Objectives To investigate the activity of the thoracic erector spinae muscles and perceived pain intensity immediately after central postero-anterior (PA) mobilisation of the thoracic spine.
Design Randomised, placebo-controlled, experimental design.
Participants and interventions Thirty-four participants with non-specific thoracic pain were randomised to the experimental group [grade III central PA mobilisation performed for 3 minutes at the level of the seventh thoracic vertebra (T7)] or the placebo group (less than grade I central PA mobilisation performed for 3 minutes at T7).
Main outcome measures Before and immediately after PA mobilisation, surface electromyography (EMG) was recorded from the thoracic erector spinae muscles as the participants performed 10° spine extension from a prone position for 10 seconds. Each participant rated their pain intensity as an investigator performed grade III central PA over the most symptomatic thoracic segment, and the pressure pain threshold (PPT) was evaluated bilaterally over the erector spinae muscles.
Results The EMG amplitude of thoracic erector spinae activity was reduced significantly after the intervention in the experimental group ($P < 0.05$), but not in the placebo group. The difference between the groups was significant {pre–post change: placebo −14 [standard deviation (SD) 50] mV, experimental 28 (SD 48) mV; mean difference −42 mV; 95% confidence interval of the difference −76 to 7; $P < 0.05$} albeit small (Grissom = 0.44). However, both groups showed a significant reduction in pain immediately after the intervention, and both groups showed a similar pre–post change in PPT.
Conclusion These preliminary findings indicate that grade III central mobilisation over the most symptomatic thoracic segment reduces thoracic erector spinae activity during extension of the trunk in people with non-specific thoracic spine pain.
Clinical trial registration number ISRCTN47601528.

Keywords: Electromyography; Mobilisation; Manual therapy; Musculoskeletal pain; Thoracic pain

Introduction

Thoracic spine pain is defined as pain experienced in the upper or middle back between the first and 12th thoracic vertebrae across the posterior aspect of the trunk [1].

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Although thoracic spine pain has lower prevalence (approximately 13%) than low back pain and neck pain, it can lead to significant functional disability and decreased quality of life [2–4]. In some cases, pain can be attributed to a primary disease (tumours, inflammation, gastrointestinal disorders, changes in bone structure, etc.); however, in most cases, it is described as non-specific [5,6].

Manual therapy has been shown to be effective for the relief of musculoskeletal pain, but few studies have focused on the thoracic region [7]. Postero-anterior mobilisation is often used for the treatment of patients with spinal pain. This technique consists of rhythmic, passive and gentle movements of the spine, where force and amplitude can be controlled according to tissue responses and the subject's presentation [8]. The mobilisation is performed in a determined range of movement or against a restrictive barrier [8,9]

A number of mechanisms underlying the beneficial effects of spinal mobilisation have been proposed, and the effect is likely achieved via a combination of biomechanical and neurophysiological mechanisms [7,10,11]. Some studies have proposed that mobilisation exerts an effect due to stimulation of mechanoreceptors or proprioceptors producing a spinal-cord-mediated effect [7,12]. Both animal [13] and human [14] studies have shown that mechanoreceptors of superficial muscles can detect small intervertebral joint motion. Other studies have suggested that neurophysiological responses with joint mobilisation are mediated by the peri-aqueductal grey matter [15] or the dorsal horn of the spinal cord [16].

One observation in people with spinal pain is increased activity of the paraspinal muscles during both isometric and dynamic tasks, possibly as a protective mechanism for painful joints [17]. Increased muscle activity may be problematic in the long term as it may increase compressive loading on the spine [18]. Although previous studies have evaluated the effect of manipulation on muscle activity [19–21], to the authors' knowledge, no studies have reported the effect of spinal mobilisation on the dorsal thoracic spinal musculature.

The aim of this study was to evaluate possible changes in activity of the thoracic erector spinae muscles and pain after central postero-anterior mobilisation of the thoracic spine. The effects of mobilisation on muscle activity and pain in participants with non-specific thoracic spine pain were evaluated. The pressure pain threshold (PPT) was also measured to provide a quantitative measure of possible changes in pain sensitivity. A placebo mobilisation was included to assess the outcome of thoracic spinal mobilisation.

Methods

A randomised, placebo-controlled, experimental study was undertaken to evaluate the effect of thoracic spine mobilisation on thoracic erector spinae muscle activity and pain in participants with thoracic spine pain. As both interventions involved therapist intervention, the participants were blinded to the intervention type.

Participants

Thirty-four participants with non-specific thoracic spine pain were sought for the study (Fig. A, see online supplementary material). Sample size was based on changes in the amplitude of electromyography (EMG) recorded from the thoracic erector spinae muscles as the primary outcome. The effect size (ES) of the EMG was estimated to be large (ES = 0.5) [20]. With a power of 0.80 and an alpha level of 0.05, it was estimated that 17 participants would be required per group (G*power 3 software) [22]. Forty-two participants were registered initially as the sample size to accommodate a 20% dropout rate; however, considering the single-session nature of the experiment, recruitment stopped when 34 participants (17 per group) had been recruited.

Participants were recruited from the general population of the University of Alcalá through advertisements between January and June 2014, and were provided with an information sheet detailing the study. Participants were included if they had acute or chronic mechanical non-specific thoracic spine pain, were aged between 18 and 30 years, and had a body mass index $\leq 29\ kg/m^2$. Subjects were excluded if they had a history of surgery, cardiovascular disorders, neurological disorders, rheumatic conditions, osteoporosis, cancer, radicular pain and/or neuropathy.

Volunteers initially completed a questionnaire regarding demographic data and symptoms relating to the thoracic region. Forty-two participants were assessed for eligibility before the required sample of 34 participants was recruited (Fig. A, see online supplementary material). Data collection took place between July and October 2014 after the trial was registered.

Ethical approval was obtained from the University of Alcalá Ethics Committee (CEI M2013/044/20140131), and the trial was registered (ISRCTN47601528). All participants provided written informed consent, and all procedures were conducted in accordance with the Declaration of Helsinki.

Instrumentation, procedure and measurements

The study was performed over a single session conducted in a laboratory at the University of Alcalá. EMG (primary outcome) and pain measures (secondary outcomes) were recorded before and immediately after an intervention performed by an investigator blinded to the group allocation of each patient. Throughout the procedure, participants were in a standardised position: prone with the arms extended along the body and the head/neck in a neutral position.

Electromyography

Following skin preparation, bipolar (20-mm interelectrode distance) surface electrodes (Biometrics SX-230, Biometrics Ltd., Newport, UK) were placed over the thoracic erector spinae muscles bilaterally at the level of the seventh thoracic vertebra (T7), 3 cm lateral to the spine [23]. EMG was