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Original article

An investigation into the effects of applying a lumbar Maitland mobilisation at different frequencies on sympathetic nervous system activity levels in the lower limb

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ABSTRACT

Background: Oscillatory Maitland mobilisations are commonly used in the management of lower back pain with research suggesting that mobilisations at 2 Hz may excite the sympathetic nervous system (SNS) more than sustained pressure glides or 0.5 Hz oscillatory mobilisations.
Objectives: Investigate the effects of increasing the oscillation frequency greater than 2 Hz.
Design: A double-blind, placebo-controlled, independent group experimental design.
Method: Sixty healthy male volunteers were randomly allocated to one of four groups; a control group (no contact), placebo group (sustained static pressure to L4 vertebra), and two intervention groups receiving a centrally applied postero-anterior mobilisation applied at either 2 Hz or 3 Hz for three 1-min periods. SNS activity was recorded by a blinded data collector by continuous skin conductance (SC) activity levels in the feet using a Biopac MP35 electrodermal amplifier. Participants were blinded to their group allocation which was further validated by a post-experiment questionnaire ($p > 0.05$).
Results: The magnitude of sympathoexcitatory response was greatest for the 3 Hz mobilisation (20%) compared with the 2 Hz mobilisation (12%), placebo (−1%) and control conditions (3%). Only the 3 Hz group demonstrated statistical significance when compared to placebo intervention ($p = 0.002$), and the control group ($p = 0.02$).
Conclusion: SC changes reflect those of previous studies using lumbar mobilisations at 2 Hz, however the 3 Hz group was found to have a greater magnitude of effect worthy of consideration within research and clinical settings. These findings provide preliminary evidence to support the use of 3 Hz oscillatory mobilisations to affect a greater magnitude of SNS activity than those previously reported (0.5, 1.5 and 2 Hz).

1. Introduction

In 2009, the National Institute of Clinical Excellence published guidelines on managing lower back pain (LBP) stating 'manual therapy' can be beneficial in the early stages of care (Savigny et al., 2009). Although these recommendations provided clinicians reassurance in selecting effective treatment pathways, there remains a lack of specificity regarding the detail of optimum therapeutic techniques and their efficacy of action.

In 1965 Geoffery Maitland was one of the first innovative physiotherapists to educate practitioners on applying a graded oscillatory force to a joint in a mobilisation technique (Banks, 2010). The legacy of these techniques is still commonly used in clinical practice, with approximately 42% of physiotherapists using Maitland mobilisations to treat LBP (Gracey et al., 2002).

Maitland et al. (2001) described strictly selected mobilisation parameters, using one oscillation per 2 s (0.5 Hz) on a painful L4 lumbar vertebra for 30–60 s at specific forces. In clinical practice, therapists conviction in adhering to these strict principles is questioned with Snodgrass et al. (2006) commenting that 1 Hz

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mobilisation frequency is currently most used. Others have criticised these strict principles as having poor rationale (Schmidt et al., 2008; Zusman, 2011). Only recently have studies investigated the application of the original Maitland parameters to provide some evidence to support treatment duration (Pentelka et al., 2012) and mobilisation amplitude (Krouwel et al., 2010), however the research remains in its infancy with quantification of effect difficult to determine objectively. Furthermore, clinical significance of how the observed treatment responses in asymptomatic participants correlate to patients with LBP is indeterminate.

Studies have investigated the sympathetic nervous system (SNS) activity and importance of non-opioid endogenous pain inhibition pathways in the mid-brain. From studies in rats (Lovick, 1991; Kuraishi et al., 1991) the activation of the descending periaqueductal grey (dPAG) resulted in analgesia in correlation with an excitatory SNS response (increased heart rate, blood pressure and respiratory rate). Authors have since proposed that manual therapy techniques may activate the central pain modulating areas of the brain including the dPAG resulting in similar hypoalgesic and sympathoexcitatory responses extending beyond the spinal segment treated (Wright, 1995; Bialosky et al., 2009). There is evidence to suggest that skin conductance (SC) increases in a widespread manner in both limbs, providing a method of recording SNS changes following passive accessory mobilisations (Schmidt et al., 2008). However it is still debated how best to objectively quantify the magnitude of effect (Potter et al., 2005), with pressure pain threshold (PPT) also being commonly used.

Studies have investigated the potential dPAG activation when applying a Maitland mobilisation in the cervical spine (Vicenzino et al., 1994, 1998; Sterling et al., 2001) but all authors failed to document the mobilisation frequency used, potentially creating large variations in technique application. Petersen et al. (1993) commented that the oscillatory component was important (60% change in skin conductance reported from baseline values), but failed to standardise the (estimated average) 1.9 Hz mobilisation used. McGuiness et al. (1997) recognised 'the rate of mobilisation is an important factor', however the author overlooked to record the oscillatory frequency performed.

Recent studies have started to address this methodological flaw with Jowsey and Perry (2010) applying a rotational mobilisation to T4 vertebra at 0.5 Hz reporting up to 16.85% skin conductance change in comparison to the placebo intervention. Perry and Green (2008) applied a 2 Hz unilateral mobilisation to L4/5 segment with significant changes in SC of 13.5% reported compared to placebo and control interventions.

To the author's knowledge, only two studies to date have directly compared two oscillation frequencies and reported quantifiable effects. Willett et al. (2010) applied a posterior-anterior mobilisation centrally to L5, comparing interventions using sustained pressure (0 Hz) with 1 Hz and 2 Hz on 30-participants. Although a 19.6% pressure pain threshold (PPT) increase was noted locally and 12% distally, no significant difference was reported between the two mobilisation frequencies. Chiu and Wright (1996) recorded SNS changes with mobilisations at 0.5 Hz and 2 Hz on C5/6 and found significant SC changes for 2 Hz (50–60%) compared with 0.5 Hz (15–20%) and control group (14–18%). No research has yet been conducted on Maitland mobilisations performed at greater than 2 Hz.

The aim of this study is to evaluate the effects on distal SC when performing an L4 PA lumbar Maitland mobilisation for 1-min with 3 repetitions on normal healthy participants. Effects of the mobilisation to be compared using a control, placebo (sustained pressure), 2 Hz mobilisation, and 3 Hz mobilisation frequency.

2. Methodology

2.1. Participant recruitment and sampling procedures

Ethical approval was obtained from Coventry University research ethics committee. All volunteer participants received written information in advance, alongside providing informed consent.

Previous studies have reported SC values in control, placebo, and spinal manual therapy groups. Based on pooled standard deviation estimate of 9.4% from Perry and Green (2008), it was calculated that 60 participants would enable a 7.5% difference in SC value to be detected from baseline at a 5% significance level and 80% power. This calculation supported 15-participants being allocated to one of four experimental groups (control, placebo, 2 Hz and 3 Hz interventions).

A convenience sample of 60 physiotherapeutically naïve, healthy pain-free male participants aged 18–25 years (mean 21.53, SD ± 2.19) were recruited from the student population at Coventry University between April to June 2014.

An all-male participant group was selected to improve group matching and to reduce the effects of oestrogen fluctuations in the menstrual cycle altering SNS activity (Hinojosa-Laborde et al., 1999; Liu et al., 2003), as supported by Chiu and Wright (1996) and Perry and Green (2008). Participants were required to be between 18 and 25 years of age with the upper limit being selected in consideration that participants were healthy, as with increasing age risks an increasing prevalence of asymptomatic annular disc pathologies reported at the L4 segment (Jull and Bullock, 1987; Boden et al., 1990; Osti et al., 1992). The 18–25 age range was also used in other studies (Chiu and Wright, 1996; Perry and Green, 2008).

Participants were excluded from the study if they had previously suffered from lower back pain, or were not naïve to the effects of physiotherapy, as it is difficult to ascertain the effects that expectancy has on SC (and PPT) when using manual therapy (Bialosky et al., 2008). Participants were also excluded if their BMI was 30 or over due to possible effects on the SNS activity regulation (Lambert et al., 2007).

To minimise the effects of stimulants influencing SC, participants were excluded if they had participated in strenuous activity, or consumed caffeine, alcohol, or nicotine 3-h prior to volunteering to participate in the study (Vicenzino et al., 1994; Chiu and Wright, 1996).

To limit other possible unknown influences on SC, subjects were also excluded from participation if they had any neurological disorders, any previous lower limb trauma, any anxiety or psychiatric disorder, or taking any medication. Individuals with pre-existing comorbidities (e.g. diabetes) were excluded due to the adverse effects the disease might have on SC readings. Participants with skin disorders were excluded due to their unknown influence on the primary outcome measure.

In total 67 volunteers were assessed for suitability through the screening process using the inclusion and exclusion criteria, with 7 volunteers not meeting the required standards.

The treating therapist had 10 years active musculoskeletal physiotherapy experience, and had completed a Manual Therapy post-graduate diploma. Using a potentiometer (Watson and Burnett, 1990), two pilot studies were conducted over a 6-day period, to establish the therapists' consistency at producing mobilisation frequency (at 2 Hz and 3 Hz) and oscillation force (over 1-min). Results provided in Table 1 revealed that although force application was comparable to previous mobilisation research (Petty, 1995; Snodgrass et al., 2006; Willett et al., 2010), intra-therapist reliability when applying greater Maitland forces, had reduced consistency of application at 3 Hz. A phenomenon