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Original article

The effects of a modified spinal mobilisation with leg movement (SMWLM) technique on sympathetic outflow to the lower limbs

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ABSTRACT

Physiotherapy management of lumbar disorders, based on Mulligan's mobilization techniques, is a treatment of choice by many physiotherapists, however, there is only limited evidence of any neurophysiological effects and much of this has focused on the cervical spine and upper limbs. This study aims to extend the knowledge base underpinning the use of a modified Mulligan's spinal mobilisation with leg movement technique (SMWLM) by exploring its effects on the peripheral sympathetic nervous system (SNS) of the lower limbs. Using a single blind, placebo controlled, independent groups study design, 45 normal naive healthy males were randomly assigned to one of three experimental groups (control, placebo or treatment; SMWLM). SNS activity was determined by recording skin conductance (SC) obtained from lower limb electrodes connected to a BioPac unit. Validation of the placebo technique was performed by post- intervention questionnaire. Results indicated that there was a significant change in SC from baseline levels (30%) that was specific to the side treated for the treatment group during the intervention period (compared to placebo and control conditions). This study provides preliminary evidence that a modified SMWLM technique results in side-specific peripheral SNS changes in the lower limbs.

1. Introduction

Manual therapy techniques based on Mulligan's concept, are gaining increasing popularity for use in musculoskeletal conditions, such as low back pain (LBP) and other disorders (Konstantinou et al., 2007). Mulligan's techniques include sustained natural apophyseal glides (SNAG'S), natural apophyseal glides (NAG'S) and mobilizations with movement (MWM'S). The application of these techniques consists of a manual force, usually in the form of a glide, applied to a motion segment and sustained while the patient actively performs their painful or restricted movement (Vicenzino et al., 2007). Mulligan (1993) originally suggested an underlying biomechanical mechanism by which these techniques were effective, based on the assumption that after an injury or a trauma, positional faults occurred in the joint with resultant pain and dysfunction. Mulligan (1993) proposed that by performing MWM techniques, the positional fault could be corrected, normal joint motion restored and symptoms abated. However, there remains a scarcity of quality evidence to refute or support this proposed mechanism.

A critical review of the literature regarding the possible mechanisms underpinning the beneficial effects of Mulligan's techniques, reported that the biomechanical hypothesis that MWM'S reverse positional faults in not well established (Vicenzino et al., 2007). Furthermore, despite patient reports of immediate pain relief, after the performance of these techniques, magnetic resonance imaging and X-rays have failed to confirm post-treatment "alterations" in the position of the bones. Vicenzino et al. (2007) suggest that the immediate effects of Mulligan's techniques on pain reduction may be neurophysiologically based (as measured by recordings of sympathetic nervous system – SNS- activity) by activating non-opioid endogenous pain inhibition pathways. Specifically, the descending pain inhibitory systems via the peri-aquaductal gray (PAG) regions in the mid-brain (Wright, 1995; Bialosky et al., 2009).

This theory was originally based on animal studies conducted by Reynolds (1969) and Lovick (1991) who demonstrated that activation of the dorsal peri-aquaductal gray (dPAG) resulted in analgesia in association with an excitatory response of the sympathetic nervous system (e.g. increased heart rate, increased blood pressure, increase of respiration). Following that report, Wright (1995) and Bialosky et al. (2009) advocate that manual therapy techniques may activate these central inhibitory systems with resultant hypoalgesic

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and sympathoexcitatory responses being recorded in both normative and patient groups (Vicenzino et al., 1995; Sterling et al., 2001).

Supporting this concept, a number of authors have investigated the neurophysiological responses to a variety of manual therapy techniques by observing the effects of these techniques on pain and/or on the sympathetic nervous system (SNS) (Vicenzino et al., 1995, 1998; Sterling et al.,. 2001; Moulson and Watson, 2006; Perry and Green, 2008; Perry et al., 2011). The results from these studies suggested that manual therapy mobilization techniques induce an immediate sympathoexcitatory response (Vicenzino et al., 1998; Sterling et al., 2001; Moulson and Watson, 2006; Perry and Green, 2008; Perry et al., 2011) that has been linked to a mechanical hypoalgesic effect (Vicenzino et al., 1998; Sterling et al.,. 2001).

However, research on Mulligan's SNAG'S and SNS activity is limited to two studies, one in the cervical spine by Moulson and Watson (2006), and the second in the lumbar spine by Moutzouri et al. (2012). Both of these studies suggested that SNAG'S performed on the cervical (C5/6 segment) and lumbar (L4/5 segment) regions elicit immediate bilateral sympathoexcitatory responses. However, only Moutzouri et al. (2012) reported percentage changes (PC) in skin conductance (SC) values (from baseline period to treatment period) therefore limiting comparison to other studies. Moutzouri et al. (2012) reported a PC in SC in the order of 11%. This response corresponds to other reports of PC in SC of 16%, for a unilaterally applied cervical spine mobilization (Sterling et al., 2001) and 13.5% for an uni-laterally applied lumbar mobilization (Perry and Green, 2008). Other authors, however, have documented percentage changes in SC responses of greater magnitude with both peripheral techniques (55% during an MWM to the elbow – Paungmali et al., 2003) and for spinal treatments (35% for a repeated extension in prone lying exercise and 75% for a lumbar manipulative procedure – Perry et al., 2011). To date, no study has investigated the immediate SNS activity responses to Mulligan's lumbar spinal mobilisation with leg movement (SMWLM) technique, which is a technique, described by Mulligan (2004: page 77), indicated for patient with LBP and radiating leg pain.

According to Mulligan (2004), this technique is performed by two practitioners working as a team with one performing the sustained medial glide on the patient's lumbar spinous process whilst the other moves, passively, the patient's uppermost leg into hip flexion. Furthermore, Mulligan (2004) advocates that on the patient's first visit, this technique should be performed only three times (rule of three) as a precaution against any latent exacerbation. Hence, following Mulligan's rule of three, after the performance of this technique, the patient's symptoms are eased and they are able to achieve greater ROM in the straight-leg raise (SLR) maneuver without radiating leg pain below the knee.

However, this study is looking at a modified version of this technique since it's being performed by only one practitioner with the assistance of a belt. The reasoning behind this modification is that many physiotherapists work alone without having a second physiotherapist to assist them. Additionally, this modified technique has, anecdotally, been found to be effective in reducing a patient's pain that is radiating below knee when performed by the investigator in a clinical setting. Thus, since the evidence for this technique is anecdotal, this study aims to contribute to the evolving evidence regarding the effects of manual therapy mobilization techniques.

2. Methodology

2.1. Participants

Data collection took place between September and November 2009. Forty five healthy male volunteers from the Coventry University student population, consented to participate. Participants were between the ages of 18–35 (mean = 23.6 years, SD = ±4.58) with no previous experience of spinal mobilization or any other physiotherapeutic intervention so as to not risk the placebo and control conditions. Furthermore, an all-male group was chosen, in order to avoid the effect of variance which the female hormone progesterone has on the skin conductance response (Venables and Christie, 1973 cited in; Perry and Green, 2008). Table 1 summarizes the subjects anthropometric characteristics. All volunteers were further assessed for their suitability using the exclusion criteria as described in the study by Moulson and Watson (2006).

Perry and Green (2008), were the first to investigate SNS activity during a unilaterally applied lumbar spinal mobilization technique recording SC values in control, placebo and treatment condition. Based on their intra-subject standard deviation of 20.3% (treatment), a power analysis calculation revealed that 45 subjects (15 per group) would enable a difference in SC from baseline of 23.8% to be detected at a significance level of $p = 0.05$ with 80% power. Hence, the current study chose a 20.3% SC value difference as a value that would represent a clinically significant change.

2.2. Research design

A single-blind, independent (matched) group, between-subjects experimental design was used. Fig. 1 illustrates the participants' progress through the study. Each participant was randomly allocated to either the control, placebo or treatment group using the third party concealed randomization method (Altman and Schulz, 2001). Specifically, randomization was done using sequentially numbered sealed envelopes each with a computer-generated random number inside with each number representing an intervention. This limits the potential for researcher and order bias (Sim and Wright, 2002).

To enhance the rigor of the study, a previously validated post-experiment questionnaire (Perry and Green, 2008) was utilized to determine the validity of the placebo condition. Furthermore, the set-up of the equipment ensured that both the treating therapist and the participant remained blind to SNS activity responses during the experimental period (Fig. 2). The interventions were performed by the principal researcher who is a manual therapist (member of the MACP) and Certified Mulligan Practitioner (CMP). Ethical approval for the study was obtained from the Coventry University ethics committee.

2.3. Research method and experimental conditions

An independent group, placebo-controlled randomized controlled trial design was employed to test the null hypotheses that there would be no difference within or between treatment groups

Table 1
Comparisons of characteristics of participants (age, weight and height) in each experimental group (control, placebo and treatment group).

	All subjects	Control group	Placebo group	Treatment group
Age (yrs)				
Mean	23.6	23.6	23.4	23.8
Range	18–34	18–33	18–31	19–34
SD	±4.58	±4.46	±4.67	±4.93
Weight (kg)				
Mean	75.2	78.4	72.6	74.4
Range	50–110	63–110	50–95	56–90
SD	±10.8	±12.47	±10.87	±8.87
Height (cm)				
Mean	179.9	182.3	178.4	179
Range	160–198	170–198	160–188	160–193
SD	±7.9	±7.14	±7.14	±8.66

Kg = kilograms; cm = centimeters; SD = standard deviation.