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Original article

The short term effects of straight leg raise neurodynamic treatment on pressure pain and vibration thresholds in individuals with spinally referred leg pain☆

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ABSTRACT

Background: Limited research exists for the effects of neurodynamic treatment techniques. Understanding short term physiological outcomes could help to better understand immediate benefits or harm of treatment.
Objectives: To assess the short-term effects of a straight leg raise (SLR) tensioner 'intervention' on pressure pain thresholds (PPT) and vibration thresholds (VT), and establish if additional factors influence outcome in individuals with spinally referred leg pain.
Design: Experimental, repeated measures.
Methods: Sixty seven participants (mean age (SD) 52.9 (13.3), 33 female) with spinally referred leg pain were divided into 3 sub-groups: somatic referred pain, radicular pain and radiculopathy. Individuals were assessed for central sensitisation (CS) and completed 5 disability and psychosocial questionnaires. PPT and VT were measured pre and post a 3 × 1 min SLR tensioner intervention.
Results: No significant differences ($p > 0.05$) were found between the 3 groups for either outcome measure, or after treatment. Slight improvements in VT were seen in the radiculopathy group after treatment, but were not significant. Only 2 participants were identified with CS. Disability and psychological factors were not significantly different at baseline between the 3 sub-groups, and did not correlate with the outcome measures.
Conclusions: No beneficial effects of treatment were found, but the trend for a decrease in VT indicated that even in individuals with radiculopathy, no detrimental changes to nerve function occurred. Psychosocial factors and levels of disability did not influence short term outcome of SLR treatment.

1. Introduction

Spinally referred leg pain predominantly occurs from nociceptive referral of spinal structures such as ligaments, muscles and disc (somatic) (Bogduk, 2009) or neural tissue. Where loss of nerve function is found, this is described as radiculopathy, whereas nerve root irritation without loss of nerve function is termed radicular pain (Bogduk, 2009). The management of such conditions varies, but for individuals where nerve root irritation is present, neurodynamic treatment (NDT) has been proposed (Cleland et al., 2006; Schäfer et al., 2011).

Adding NDT treatments to other techniques for spinally referred leg pain has shown some benefits (Cleland et al., 2006; Adel, 2011; Nagrale et al., 2012), however it is not known why such improvements in outcome occur. Limitations of the studies do not clarify the reason for the improvements. Some authors have suggested that applying NDT tensioner techniques to individuals with neuropathic pain may have detrimental effects (Boyd et al., 2005; Dilley et al., 2005). In contrast, recent animal studies have indicated that tensioner techniques not only positively influence pain behaviours, but may also have positive effects on inflammatory

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cells within the dorsal horn (Martins et al., 2011; Santos et al., 2012). Such gaps on the effects of NDT in the literature and potential for detrimental changes require further investigation.

Change in pain is an essential measurement when assessing the effects of treatment interventions, and pressure pain thresholds (PPT) are widely used within the literature (Sterling et al., 2001; Silva et al., 2013). PPT are reliable (Antonaci et al., 1998; Walton et al., 2011) and provide a semi-objective measure of pain. However, pain changes alone only give an indication of one aspect of outcome. In individuals with neuropathic pain, changes to nerve function after NDT are important because inducing strain to the nerve of greater than 8% may reduce circulation (Jou et al., 2000; Driscoll et al., 2002), and impair nerve conduction (Kwan et al., 1992; Wall et al., 1992). Whilst small levels of strain have been found in the nerve roots during SLR in cadavers (<3.4% (Smith et al., 1993)), neuropathy may detrimentally affect normal nerve mechanics (Boyd et al., 2005; Kobayashi et al., 2010).

Vibration thresholds (VT) have been utilised as an early indicator of deterioration in nerve function. They are more useful than nerve conduction testing because they are sensitive to minor nerve dysfunction and specifically test the large diameter afferents, which deteriorate after nerve root compression (Kawakami et al., 1994; Chatani et al., 1995; Freynhagen et al., 2008).

Treatment outcomes may be affected by a number of variables, including high levels of disability (Heymans et al., 2010; Hill et al., 2011) and psychosocial factors (Jensen et al., 2010; Haugen et al., 2012). The presence of central sensitisation (CS) is also considered to be a poor predictor of outcome for manual based interventions (Jull et al., 2007). It isn't known whether these factors influence the physiological responses to NDT.

The aim of this study was to assess the short term effects of a SLR tensioner technique on PPT and VT in individuals with spinally referred leg pain, and to establish if certain factors had an impact on outcome. Whilst short term outcomes have limitations in terms of extrapolation into clinical practice, this study looked at what factors might impact on these physiological measures in different subgroups of individuals with spinally referred leg pain, rather than looking at the overall effectiveness of treatment, where long term and functional outcomes are most desirable.

2. Methods

The study received ethics approval from the host university's Faculty of Health and Social Science Ethics and Governance panel, and the UK's NHS ethics panel (REC reference 12/LO/0397).

2.1. Participants

Participants were recruited from Physiotherapy waiting lists of 3 NHS trusts in the South East region of the UK. Participants who were not currently undergoing treatment for their pain were also recruited via University email and adverts in local newspapers. Participants were included if they had spinally referred leg pain for greater than 3 months, without other medical problems such as diabetes, rheumatoid arthritis or other systemic disorders. All participants were given an information sheet and signed a consent form prior to commencement in the study. The participants attended 2 sessions; the first to sub-group and ensure their eligibility and the second was the experimental stage of the study.

2.2. Sub-grouping

Participants were assessed by one of 6 experienced Physiotherapists with at least 4 years' experience in musculoskeletal practice. Training was given to all Physiotherapists prior to the commencement of the study.

Full subjective and physical examinations of each participant were performed, before allocating each individual into one of 3 sub-groups (Fig. 1). If participants complained of more than 2 signs of CS (pain > 6 months (O'Neill et al., 2007), widespread areas of pain (Jensen et al., 2010), hypersensitivity to warmth or cold (Berglund et al., 2002), and hypersensitivity to touch (O'Neill et al., 2007; Jensen et al., 2010)), an examination of painful points was undertaken (Fig. 2). The algometer (Wagner FPK, Greenwich, USA) was placed on each of the points, and the pressure increased up to 4 kg/cm^2. If more than 8 of the points were painful, the participants were considered to have CS (Jensen et al., 2010).

2.3. Experimental stage

Participants attended the laboratory a minimum of 48 h after their initial assessment.

Participants filled out 5 questionnaires: Fear avoidance belief questionnaire (FABQ), Tampa scale of kinesiophobia, Oswestry disability index (ODI), Depression, anxiety and stress scale (DASS), and Pain catastrophising scale (PCS).

Height and weight measurements were taken of all participants. The order of PPT or VT measurements was randomly allocated by asking participants to choose a piece of paper from a bag written with either V or P. All measures were taken by one researcher blinded to the group allocation of participants.

2.3.1. Vibration threshold testing

Participants lay prone and a practice VT was obtained from the unaffected side on the plantar surface of the base of the first metatarsal using a vibrameter (Somedic AB, Sweden). The probe was placed perpendicular on the metatarsal so that the weight of the probe rested fully on the area. Vibration was slowly increased until the participant felt the onset. The stimulus was then increased before being reduced again until the participant could no longer feel the sensation. Once a consistent measure (within 10%) had been demonstrated, VT readings were taken from the same site on the affected side. Three vibration appearance values and 3 vibration disappearance values were taken. The participant was then asked to lie on their unaffected side and VT readings were taken from the lateral malleolus of the affected side.

2.3.2. Pressure pain thresholds

Participants lay prone and a practice PPT was taken from the unaffected leg with a tracker freedom wireless algometer (J Tech Medical, Salt Lake City, U.S.A.) over the gastrocnemius belly and tibial nerve to familiarise the participant to PPT.

PPTs were taken from the middle portion of the deltoid muscle on the unaffected side, the tibial nerve behind the knee, and gastrocnemius (a point marked one third of the distance between the knee crease to the top of the calcaneal tuberosity) on the affected side.

Participants lay on their affected side and the probe placed perpendicular to middle portion of deltoid with pressure applied at the rate indicated by the pacer (1 kg/s). Participants were asked to push a hand plate when the sensation of pressure changed to one of discomfort. The participant turned prone and the same procedure was repeated for the tibial nerve behind the knee, before moving on to the gastrocnemius point. Two further readings were taken from each site, giving a total of three for each site.

2.3.3. Treatment procedure

All participants regardless of grouping had the same treatment procedure. Participants lay supine on the plinth with an ankle foot