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Original Article

The initial effects of different rates of lumbar mobilisations on pressure pain thresholds in asymptomatic subjects

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ABSTRACT

Lumbar mobilisations are commonly used in clinical practice to reduce pain and increase function. Mobilisations to the cervical spine have been shown to reduce pain using pressure pain thresholds (PPTs). Yet there is no evidence to confirm that this happens in the lumbar spine. Furthermore little is known about the effects of different treatment doses on the amount of hypoalgesia produced. It is unknown if changing the rate of application of mobilisations has an effect on hypoalgesia. The aim of this study was to investigate the immediate effects of lumbar posteroanterior mobilisations performed at different rates on PPT and the extent of the hypoalgesia.

A repeated measures, single blind, randomised-trial was conducted on 30 asymptomatic subjects. PPTs were measured at 4 sites in the upper and lower quadrants, before and after the application of lumbar posteroanterior mobilisations performed at 2 Hz, 1 Hz and quasi-static. The results demonstrated an immediate and significant improvement in PPT measures ($P = 0.000$) irrespective of the rate or site tested. The effects were both local and widespread. There was no significant difference in PPT between the rates of mobilisations.

This study provides new experimental evidence that lumbar posteroanterior mobilisations produce an immediate and significant widespread hypoalgesic effect, regardless of the rates of mobilisation in asymptomatic subjects.

1. Introduction

Passive joint mobilisations are often employed by physiotherapists in the treatment of spinal pain (Foster et al., 1999; Gracey et al., 2002). The underlying mechanisms by which mobilisations produce clinical effects remain largely unknown, a number of theories have been hypothesised including direct effects on articular and periarticular structures and on the biochemical environment, modulation of nociceptive input within the central nervous system and non-specific placebo effects (Zusman, 1986; Wright, 1995).

A number of studies have looked at the immediate effects of mobilisations on pain. Mobilisations to the cervical spine have been shown to provide a hypoalgesic effect as measured by pressure pain thresholds (PPTs) in asymptomatic subjects (Vicenzino et al., 1995), in patients suffering from neck pain (Sterling et al., 2001) and lateral epicondylalgia (Vicenzino et al., 1996, 1998). A hypoalgesic effect has also been demonstrated following mobilisations to peripheral joints in the upper and lower limbs (Paungmali et al., 2003; Moss et al., 2007; Teys et al., 2008). However this effect remains to be demonstrated in the lumbar spine in response to mobilisations.

To date only one study has investigated the hypoalgesic effect of lumbar mobilisations; a drop in PPT values was demonstrated (Dhondt et al., 1999). This research used a combination of lumbar techniques, rotations and posteroanterior (PA) mobilisations on subjects with rheumatoid arthritis (RA). The drop in PPT measures was demonstrated in both the control and treatment groups; however significantly higher PPT values ($p < 0.05$) were found in the group receiving the mobilisations. A number of difficulties arise from this study; the lack of standardisation of the mobilisations, the underlying pathology of the subjects together with the fact some had low back pain (LBP) whilst others did not. There was continued use of medication including analgesics during the study, which may have influenced the endogenous pain relieving mechanisms. It is possible that subjects with acute inflammatory disease respond differently to subjects without inflammatory disease; RA is listed as a precaution to mobilisations especially in the presence of acute inflammation (Grieve, 1984). Further research is therefore required

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to clarify if there is a hypoalgesic effect in response to mobilisations in the lumbar region in subjects without underlying inflammatory disease.

Mobilisations are used in different dosages and various parameters form the basis of the treatment dose; these include force, amplitude, rate, repetition and time. There is a paucity of evidence on the different aspects of treatment dose and therefore a lack of information on which clinicians base their decisions in order to produce a hypoalgesic effect. The primary aim of this study is to look at one specific aspect of treatment dose, the rate of mobilisation.

It has been reported that physiotherapists using spinal PA mobilisations, mobilise at frequencies between 0 and 2 Hz (static – 2 oscillations per second) (Souvlis et al., 2004), it is unclear if this aspect of the treatment dose is important in producing hypoalgesia. There are currently 4 studies investigating the effects of rate of mobilisations on a range of outcome measures; intervertebral movement (Lee and Evans, 1992; Lee and Svensson, 1993), skin conduction (Chiu and Wright, 1996) and PPTs (Williams et al., 2006).

Williams et al. (2006) using an osteopathic technique on healthy subjects to mobilise the ribs, found mobilising at 0.5 Hz had a greater effect than at 2 Hz on PPT measures, yet the percentage change was below 10% for both sets of mobilisations. However, the faster rate of mobilisation of 2 Hz produced greater changes in skin conduction compared to 0.5 Hz following cervical PA mobilisation in healthy males (Chiu and Wright, 1996). This suggests an application of mobilisations at frequencies of 2 Hz may cause a greater increase in sympathetic efferent activity in the upper limb of asymptomatic male volunteers than the slower rate. Whilst a correlation exists between PPTs and sympathetic nervous system changes (Vicenzino et al., 1998; Sterling et al., 2001), there is no evidence at this point in time as to whether these changes are interdependent and therefore whether pain would be affected.

Still looking at frequency, biomechanical studies investigating the effects of different rates of PA mobilisation on intervertebral movement in asymptomatic subjects, have found sustained (quasi-static) PA mobilisations to the spine have produced greater intervertebral displacement than mobilisations at frequencies of 1 Hz and 2 Hz (Lee and Evans, 1992) and 0.5 Hz and 1 Hz (Lee and Svensson, 1993). Further studies are needed to investigate if there is a correlation between joint displacement and hypoalgesia.

The purpose of this study is to establish if the rate of central PA mobilisations on L5 is significant in producing optimum hypoalgesia as measured by PPTs in asymptomatic subjects and the extent of the hypoalgesia; whether it is local, regional and/or systemic.

2. Method

2.1. Subjects

The study recruited 30 asymptomatic subjects (22 female and 8 males) aged between 18 and 57 years from the University of Brighton by posters and email. Basic demographics can be seen in Table 1.

Volunteers underwent a screening process that ensured those selected for the study were aged between 18 and 60 years, healthy with no contraindications or precautions to manual therapy (Grieve, 1984) and furthermore had no history of LBP within the last 2 years or LBP that had ever required treatment. Eleven of the subjects were physiotherapy naïve. The subjects gave their written, informed consent before participating in the study which had been approved by the University of Brighton's School of Health Professional's Research Ethics Committee.

Table 1
Demographics: standard deviation (SD), number (N), Body mass index (BMI).

	Age	Height	Weight	BMI
Female $N = 22$	Mean 29.6 SD 10.3 range 18–53	Mean 166.5 cm SD 7.44 range 155.5–175	Mean 65.45 kg SD 10.64 range 51–95	Mean 23.5 SD 3.2 range 18.3–33.7
Male $N = 8$	Mean 36.5 SD 14.2 range 22–57	Mean 175.4 cm SD 6.3 range 164–185	Mean 87.12 kg SD 23.5 range 70–140	Mean 28.81 SD 6.1 range 22–40.9

2.2. Research design and experimental procedure (independent variable)

The research design used a single blind, randomised, within subjects, repeated measures design which included 3 experimental procedures in a randomised order. Randomisation for each participant was established by "the research randomiser" (Urbaniak and Plous, 2007) in order to reduce the effects of researcher and order bias (Altman, 1991). Subjects received all 3 experimental conditions on separate occasions with a minimum of 48 h between testing procedures.

The experimental procedure was applied by a physiotherapist with 23 years postgraduate experience in neuromusculoskeletal physiotherapy. It consisted of large amplitude, grade III, central PA mobilisations using a pisiform grip (Maitland, 1986) to L5 spinous process, for 3 sets of 1 min, with a 1 min rest period in between each set. The rates of the PA mobilisations varied at each experimental session and were performed at either 1 Hz, 2 Hz or as a quasi-static pressure. To maintain a consistent rate of mobilisations a metronome was set at 1 Hz, 2 Hz or left silent. The amplitude of the mobilisations were standardised by the use of a plinth mounted on a force plate (AMTI OR6-7 Advanced mechanical Technology Inc, MA USA) linked to a computer screen, which showed a trace pattern of the mobilisations. The amplitude of the oscillations for the rates 1 Hz and 2 Hz was standardised by using a force from 100 to 200 N and a near static force of 200 N was used for the quasi-static technique.

2.3. Outcome measures (dependent variable)

Algometry is often used in research as a quantitative measure of pain. Excellent reliability has been demonstrated using algometry to measure PPT (Fischer, 1987; Vanderween et al., 1996; Keating et al., 2001; Farasyn and Meeusen, 2005; Potter et al., 2006) ranging from 0.8 to 0.99 between sessions and >0.91 within sessions. Pain pressure thresholds were measured using an electronic pressure algometer (Tracker Computerized Algometry System, JTECH medical). The algometer has a circular 1-cm^2 metal tip which is applied perpendicular to the skin at a gradual standardised speed of 1 kg/s following a pacer on the computer screen linked to the algometer. The subjects were instructed to activate a switch linked to the computer recording the PPT measurement, immediately the sensation turned from one of pressure to pain (Fischer, 1987).

At each experimental session the 4 landmarks (Fig. 1) for the PPT testing procedure were marked with a water-soluble pen. It was found during the pilot work that L5 became sensitised during PPT testing therefore the paraspinal muscles adjacent to L5 were chosen as a landmark local to the mobilisations. The signature zones for the L2 and L5 dermatomes (Wolf, 1981; Nitta et al., 1993) were chosen to help eliminate the invariable overlap between dermatomes and therefore presenting a clear distinction between L2 and L5 in order to measure the extent of any hypoalgesic response. The first dorsal interossei in the hand was selected because to the large amount of