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Research report

The effects of high-velocity, low-amplitude manipulation and muscle energy technique on suboccipital tenderness

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Abstract

Background and objectives: High-velocity, low-amplitude (HVLA) manipulation and muscle energy technique (MET) are commonly advocated by manual therapists to resolve pain and dysfunction. The aim of this controlled, single blinded study was to investigate whether HVLA manipulation of the occipito–atlantal (OA) joint and/or an MET stretch had an effect on pressure pain thresholds (PPT) in the suboccipital musculature in an asymptomatic population.
Methods: Participants ($N = 90$; mean age $= 23 \pm 5$; 29 males and 61 females) were screened for suitability and PPT measurements were made using a hand-held electronic algometer which was positioned centrally in the suboccipital region. Participants were randomly allocated into three intervention groups and then received an HVLA thrust to cavitate the right and left OA joints, an MET stretch applied to the suboccipital muscles bilaterally, or a sham 'functional' technique. Post-intervention PPT measurements were recorded at 5 and 30 min.
Analysis: Analysis of the PPT data using a SPANOVA revealed a significant difference over time ($F_{2,174} = 8.80$, $P < 0.01$), but no significant difference between the groups ($F_{2,87} = 0.08$, $P = 0.93$). Within-group changes were further analysed using paired *t*-tests and repeated measures ANOVA which revealed significant changes at 5 min post treatment in the HVLA ($P < 0.01$) and MET groups ($P < 0.01$), but not in the control ($P = 0.35$). At the 30 min interval a significant change was calculated for the MET group ($P < 0.03$), but not in the HVLA ($P = 0.29$) or control group ($P = 0.21$).
Conclusion: Neither HVLA manipulation nor MET significantly changed the PPT of the suboccipital muscles in asymptomatic participants. Both techniques produced greater mean increases in PPT and effect sizes compared to the control group, and investigation of the effect of these techniques in a symptomatic population is recommended.

Keywords: Manipulation; Stretching; Suboccipital; Muscles; Occipito–atlantal joint; Algometry; Osteopathic medicine

1. Introduction

High-velocity, low-amplitude (HVLA) manipulation and muscle energy technique (MET) are manual techniques advocated by osteopathic authors to restore spinal range of motion and to decrease pain.[1–3] HVLA involves the application of a fast non-forceful thrust, which is often associated with an audible 'pop' or 'crack'.[1] MET differs from HVLA in that it is an active technique requiring the patient to contribute the corrective force.[2] MET has been described as a valuable treatment technique because of the many claimed therapeutic benefits resulting from a single procedure, including lengthening and strengthening muscles, increasing fluid mechanics and decreasing local oedema, mobilising restricted articulations and reducing pain and disability.[2,4–6] The

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application of MET involves the voluntary contraction of patient muscle in a precisely controlled direction, at varying levels of intensity and against a distinctly executed counterforce which is applied by the operator.[2]

A small number of studies support the short-term hypoalgesic effects of HVLA manipulation.[7–10] Terret et al.[7] reported an immediate rise in cutaneous pain threshold following spinal manipulation, and noted distinct and progressive elevation in pain tolerance within 2 min, lasting at least 10 min post-manipulation, in comparison to the control group. Similarly, Vernon et al.[8] found individuals suffering chronic neck pain who received HVLA manipulation experienced a significant rise (40–55%) in pressure pain thresholds (PPT) for all four points around the manipulated spinal segment, as compared to the small change following mobilisation treatment. However, because of the small sample size ($n = 9$), the findings of this study should be treated with caution.

Fryer et al.[9] reported that both HVLA and mobilisation had a significant effect on perceived tenderness over the thoracic spine in a group of asymptomatic participants. However, HVLA was less effective for increasing the PPTs when compared with mobilisation, and a significant difference existed between the mobilisation and control group ($P = 0.01$), but not between the manipulation and control group ($P = 0.67$). These findings conflicted with those of Cassidy et al.[10] who reported that a single HVLA technique was significantly more effective in 85% of participants when compared to MET for treating neck pain. In recent systematic reviews, spinal manipulation has been recommended with some confidence to be a viable option for the treatment of both low back pain and neck pain.[11,12]

The mechanisms by which HVLA produces a hypoalgesic effect are largely speculative. Melzack and Wall[13] proposed the gate control theory, where large diameter myelinated neurons from mechanoreceptors modulate and inhibit the smaller diameter nociceptive neuronal input at the spinal cord level. Joint manipulation would activate mechanoreceptor afferents and may therefore provide pain relief by activating this spinal gate control mechanism. Any technique that stimulates joint proprioceptors via the production of joint movement or the stretching of a joint capsule has been proposed to be capable of inhibiting pain.[14]

It has also been speculated that HVLA may have a therapeutic effect by reducing zygapophyseal joint effusion and peri-articular oedema by improving the drainage of flow within a joint, or by stretching of zygapophyseal joint capsules to improve joint range of motion. It has been suggested that manipulative techniques play a role in descending pain control systems projecting from higher centres such as the dorsal periaqueductal grey (dPAG) to the spinal cord.[15] Manipulation induced hypoalgesia and the improvement of proprioception and motor control may play a role in the short and long-term relief of patients.[14] These proposals, however, would not be relevant to hypoalgesia following HVLA in asymptomatic individuals.

MET has been advocated as a safer alternative to HVLA, particularly for the upper cervical spine.[2,16,17] The origins of MET are claimed to extend back to the days of A.T. Still,[18] the technique was developed and popularised by Mitchell[2] and despite many texts advocating the use of MET it is surprising how limited the research is with regards to its effectiveness.[4–6] Of the few studies published to date, most have examined the effect of MET for increasing flexibility and range of motion.[19–23] Only one study was found that examined the effect of MET on spinal pain, and this study suggested that MET was effective for reducing pain and disability in patients with low back pain.[4]

Pressure algometry is a method of quantifying soft tissue tenderness which has been proven to be very reliable.[24–27] The PPT is defined as the least stimulus intensity at which an individual perceives pain; it is the point where the sensation of pressure turns to one of pain.[24] Sterling et al.[26] found that the measurement of pain thresholds with an electronic algometer was reliable between weeks (1 week period) in both asymptomatic participants and in participants with chronic back pain. Nussbaum and Downes[25] recommended that the measurements be taken by one examiner, because this was more reliable than from multiple examiners.

Significant regional differences in spinal PPT values have been reported, where the PPT increases in a caudal direction. Cervical segments have been determined to be the most sensitive to pressure, followed by the thoracic region and the lumbar spine.[28,29] Vanderweeen et al.[24] suggested this pattern might be due to the higher nociceptor density in the cervical spine.

The suboccipital region is one zone of particular clinical importance when assessing and treating the cervical spine.[30] This triangular area inferior to the occipital bone includes the posterior aspects of C1 and C2 vertebrae and four small muscles: rectus capitis posterior major, rectus capitis posterior minor (RCPMn), obliquus capitis superior and obliquus capitis inferior. The suboccipital muscles have been suggested to act as a 'kinesiological monitor' for the sense of proprioception, as well as having an affect on movement of the head.[30] The RCPMn has been described by McPartland and Brodeur[16] as containing a high density of muscle spindles and therefore dysfunction at this level may disrupt proprioception of the head and cervical spine. Dysfunction of the suboccipital muscles has been claimed to arise from any trauma that causes sudden or extreme movement of the head, or simply from chronic postural stresses, such as those occurring during slouching and the typical "chin poking" posture.[16,31]