The Effect of Cervical Spine Manipulation on Postural Sway in Patients With Nonspecific Neck Pain

Alison R. Fisher, MOst,[a] Catherine J. Bacon, MSc, PhD,[b c] and Jamie V.H. Mannion, PGDipSci, MSc[d]

Abstract

Objective: This crossover study aimed to determine whether a single high-velocity, low-amplitude manipulation of the cervical spine would affect postural sway in adults with nonspecific neck pain.

Methods: Ten participants received, in random order, 7 days apart, a high-velocity, low-amplitude manipulation applied to a dysfunctional spinal segment and a passive head-movement control. Four parameters of postural sway were measured before, immediately after, and at 5 and 10 minutes after each procedure.

Results: Results showed no differences between interventions in change in any of the parameters. When changes before and immediately after each procedure were analyzed separately, only the control showed a significant change in the length of center of pressure path (an increase from median, 118 mm; interquartile range, 93-137 mm to an increase to 132 mm; 112-147; $P = .02$).

Conclusion: This study failed to show evidence that single manipulation of the cervical spine influenced postural sway. Given the ability of the postural control system to reweight the hierarchy of sensory information to compensate for inadequacies in any 1 component, it is possible that any improvements in the mechanisms controlling postural sway elicited by the manipulative intervention may have been concealed. (J Manipulative Physiol Ther 2015;38:65-73)

Key Indexing Terms: *Neck Pain; Central Nervous System; Cervical Manipulation; Neuronal Plasticity; Posture*

Dysfunction within components of the postural control system has been associated with an increase in postural sway and in energy expenditure required to maintain upright stance.[1,2] Therefore, it is a basic assumption of many measurements of postural equilibrium that the magnitude of postural sway is a reflection of the integrity of the postural control system.[3,4] Several studies have noted that individuals with both experimental[5] and clinical[3,6,7] neck pain exhibit 130% to 170% greater postural sway, during normal stance with eyes open, when compared with asymptomatic controls. Neck pain is also associated with impairment in other measures of balance, and these have been recently reviewed.[8]

The cervical region plays an important role in supplying proprioceptive information to the postural control system. This is reflected by the dense concentration of proprioceptive organs within cervical musculature and the extensive network of connections that cervical afferents form with numerous components of the postural control system.[9] The importance of cervical afferents to postural control has been eloquently demonstrated by experimental studies, which found that vibration of neck musculature in healthy individuals resulted in disrupted gait[10] and increased postural sway.[11]

Somatic pain is associated with extensive neuroplastic changes in regions responsible for sensory processing and interpretation, motor planning, and emotional and behavioral responses.[12] It is thought that these changes may be responsible for the development and maintenance of functional impairments seen in neck pain sufferers.[13,14] Examples include altered processing of sensory information,[15] reduced kinesthetic sensibility of the cervical spine,[16] delayed feedforward activation of postural musculature,[17] reduced

[a] Osteopath, Department of Osteopathy, Unitec Institute of Technology, Auckland, New Zealand.
[b] Research Supervisor, Department of Osteopathy, Unitec Institute of Technology, Auckland, New Zealand.
[c] Postdoctoral Research Fellow, Faculty of Medical and Health Sciences, University of Auckland, Auckland, New Zealand.
[d] Lecturer, Department of Osteopathy, Unitec Institute of Technology, Auckland, New Zealand.
Submit requests for reprints to: Catherine J. Bacon, BSc, BPhed (Hons), MSc, PhD, Faculty of Medical and Health Sciences, University of Auckland, Private Bag 92019, Auckland 1142, New Zealand. (e-mail: *c.bacon@auckland.ac.nz*).
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neuromuscular efficiency,[18] altered motor patterning, and increased fatigability of cervical musculature.[19] Such pain-induced disturbances to important components of the postural control system, in conjunction with altered cervical proprioceptive input, are thought to be significant contributing factors to the increased postural sway observed in individuals with neck pain.[3,20,21]

High-velocity, low-amplitude (HVLA) spinal manipulation has long been used by manual therapists in the treatment of musculoskeletal complaints.[22,23] Cervical spine manipulation to individuals with neck pain has been shown to reduce pain levels locally and in peripheral sites,[24,25] increase force production by improving recruitment of inhibited musculature,[26-28] and improve kinesthetic performance.[29,30]

Despite the evidence of promising therapeutic and sensorimotor effects of HVLA manipulation of patients with painful neck disorders, the mechanisms underlying this technique are still unclear. A series of studies by Haavik and Murphy[31-33] has demonstrated acute alterations in cortical activity in regions related to sensory processing and sensorimotor integration changes up to 30 minutes after cervical spine manipulation to dysfunctional segments in patients with neck pain. From these data, it has been proposed that improvements in neuromuscular performance after manipulation in patients with neck pain may result directly from the normalization of aberrant proprioceptive input associated with neck pain[21] or indirectly from the analgesic effects of the technique itself.[34]

Thus, because postural sway responds immediately to disturbance of cervical afferents[11] and because neck manipulation has been shown to result in acute improvements in sensorimotor integration,[21] recent studies have hypothesized an effect of a single HVLA cervical spine manipulation on the postural sway of asymptomatic individuals. Two of these studies demonstrated significant reductions in postural sway after cervical spine manipulation with eyes open[35] and eyes closed.[36] By contrast, a study by Palmgren et al[29] reported no significant change in postural sway in measurements with both occluded vision and full vision. Although Haavik and Murphy have demonstrated relevant immediate changes in cortical function after manipulation in patients with neck pain, to date, no studies explore the potential for HVLA spinal manipulation to acutely influence postural sway in individuals with neck pain. In this study, we therefore investigate 1 mechanism for the observed effects of cervical spine manipulation on neck pain by examining the effect of a single HVLA manipulation to the cervical spine of individuals with neck pain on postural sway in the eyes open condition.

Methods

Participants

Adults between the ages of 18 and 55 years with neck pain for at least the previous 4-week neck pain were invited to participate in this study in posters placed in a training osteopathy clinic at Unitec, Auckland, New Zealand, and on the participant recruitment Web site ResearchStudies.co.nz.

To be eligible, participants were also required to have a dysfunctional segment within the cervical spine, defined as the presence of restricted intersegmental range of motion and tenderness on palpation of the joint.[37] Assessments of range of motion and tenderness have been shown to have good to excellent interexaminer reliability for cervical range of motion,[38,39] in contrast to palpable paravertebral muscular tissue texture change.[37,40]

Participants were ineligible for the study if, in a medical screening questionnaire, they reported possible contraindications to cervical spine manipulation,[41] subjective symptoms of vertebrobasilar insufficiency,[42] or if, under examination, they exhibited signs or symptoms suggestive of the presence of vertebrobasilar insufficiency using a provocation test in accordance with Australian Physiotherapy Association clinical guidelines.[42,43]

After expressing interest in the study, the aims and procedures involved in the study were explained verbally to prospective participants; and they were sent a formal information sheet and consent form. Written, informed consent was obtained from each participant. This study was approved by Unitec Research Ethics Committee (UREC 2011-1188) and registered with the Australian New Zealand Clinical Trials Registry (ACTRN12613001254785).

Experimental Protocol

A randomized controlled trial design with crossover was used. Each participant attended 2 sessions, 1 week apart, in which they received either the cervical spine manipulation or a passive head movement control. The passive head movement was designed as a physiologic control for any possible changes occurring due to the vestibular or mechanical input from passively preparing the participants' heads for the cervical spine manipulation intervention. The order of treatments was determined via random generation of an odd or even number, using Web-based software (www.random.org), after enrolment at the time participants arrived for their first treatment session, so foreknowledge of upcoming allocation was prevented.

Procedures

The procedures were performed by a registered osteopath, who had also conducted the screening examinations. The cervical spine manipulation intervention consisted of a single HVLA thrust to the identified dysfunctional segment. The passive head movement control involved the participant's head being gently and passively side bent and rotated into the position that the practitioner would normally manipulate. The participants' head was then returned to a neutral position.