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Original article

Cervical & thoracic manipulations: Acute effects upon pain pressure threshold and self-reported pain in experimentally induced shoulder pain

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ABSTRACT

Background: Emerging evidence suggests that cervical and thoracic joint manipulations may be advocated in treating patients with shoulder pain.
Objectives: To determine the acute effects of cervical, cervicothoracic, and thoracic joint manipulations on outcomes of self-reported pain and pain pressure threshold in experimentally induced shoulder pain.
Design: Repeated measures.
Methods: Twenty (20) healthy volunteers were tested on two sessions. Session 1 consisted on baseline assessment of pain pressure threshold testing over the infraspinatus bilaterally and self-reported shoulder pain using the shoulder pain and disability index (SPADI) pain scale. An isokinetic exercise protocol was used to induce delayed onset muscle soreness. In session 2 (24–48 h later), all variables were reassessed before and immediately after a combination of cervical, cervicothoracic and thoracic manipulations.
Results: SPADI pain scale scores were significantly different between time points ($p < 0.001$): the exercise protocol significantly increased reported pain [mean increase 14.1, $p < 0.001$] while the manipulation significantly decreased reported pain (mean decrease 5.60, $p < 0.001$)) although pain remained higher than baseline levels. Pain pressure threshold differences were also found between time points ($p = 0.001$): manipulation significantly increased pain threshold bilaterally ($p < 0.001$) similar to baseline levels.
Conclusions: Cervical, cervicothoracic, and thoracic joint manipulations acutely increased pain pressure threshold and decreased self-reported shoulder pain in participants with experimentally induced shoulder pain. Physiotherapists may consider the combination of such techniques to achieve short-term hypoalgesic effects and facilitate the application of more active interventions.

1. Introduction

Shoulder pain is among the most common pain location with point prevalence rates ranging from 7 to 26% in the general population (Luime et al., 2004). Given this, physical therapists have many interventions directed toward decreasing patients' complaints of shoulder pain including exercise, joint mobilization, and electrical and thermal modalities (Green et al., 2003).

Manual therapy, specifically vertebral joint manipulation, is commonly utilized and advocated in treating a variety of musculoskeletal disorders (Flynn et al., 2002; Wainner et al., 2007; Iverson et al., 2008; Boyles et al., 2009; Mintken et al., 2010; Childs et al., 2011; Delitto et al., 2012). A recent systematic review has indicated that there is potential for benefit of shoulder conditions by treating the thoracic spine with manual therapy (Walser et al., 2009). The concept underlying this type of treatment has been described as regional interdependence, whereby impairments in one region can be linked, biomechanically and/or neurophysiologically, to impairments in neighboring anatomical regions (Wainner et al., 2007; Bialosky et al., 2009). Emerging evidence has

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suggested utilizing spinal manual therapy to cervical and thoracic regions to treat patients with shoulder pain (Bergman et al., 2004; Boyles et al., 2009; Mintken et al., 2010; Muth et al., 2012). Reported benefits of spinal treatments for shoulder patients include increased pain free shoulder range of motion, decreased overall pain, improved self-reported function, and decreased provocative testing for shoulder injury (Mintken et al., 2010; Muth et al., 2012).

One of the challenging aspects of treating shoulder pain is the range of pathoanatomical diagnoses that may be involved in pain origination (Dean et al., 2013). Unlike clinical practice, experimental pain models provide the opportunity for assessment of the efficacy of interventions on a reasonably uniform type of injury or painful condition (Staahl and Drewes, 2004). This study utilized an exercise induced delayed onset muscle soreness pain protocol. This method of simulating shoulder pain is appropriate given the pathophysiology and inflammatory changes created are similar to acute shoulder injury commonly found in younger individuals (Clarkson and Hubal, 2002; George et al., 2007). The aims of this paper were to determine the impact of cervical, cervicothoracic and thoracic manipulation on experimentally induced shoulder pain in a group of healthy young volunteers using both subjective self-reported pain measures and objective quantitative sensory testing (pain pressure threshold).

2. Methods

2.1. Participants

A sample of convenience consisting of healthy volunteers participated in this study. Participants were between the ages of 23 and 27 years. This age group was specifically chosen to decrease the likelihood of age related degeneration of the shoulder muscles (Milgrom et al., 1995). Participants were considered healthy using the following criteria: denied any history seeking medical care for shoulder or neck injuries, and reported no current (past 6 months) shoulder or neck pain. Exclusion criteria consisted of prior shoulder surgery or fracture, and contraindication to cervical or thoracic manipulation as determined by medical screening from the principal investigator (CAW) (Cook, 2012). Participants were not seeking treatment for any other musculoskeletal disorder either. All testing was completed in a University research laboratory using procedures approved by the East Tennessee State University Institutional Review Board. All participants provided informed consent as per University guidelines. Equal numbers of males and females were recruited as differences have been noted in pain reporting between genders (Stohler et al., 2001).

2.2. Study design

A repeated measures design was employed in this project with testing occurring in 2 sessions completed on separate days (Fig. 1). The first testing session consisted of screening for vertebrobasilar insufficiency (VBI), baseline outcome measures [self-reports shoulder pain (shoulder pain and disability index (SPADI) pain scale only); pain pressure threshold], maximal isometric shoulder strength in a modified neutral position, and completion of a standardized eccentric exercise protocol designed to induce shoulder pain via delayed onset muscle soreness (Chapman et al., 2006; Chen et al., 2009). Participants returned for day 2 of testing 24–48 h after the first session as peak soreness has been reported to occur between 24 and 72 h post exercise. They were asked not to exercise their upper body or utilize any treatments (ice, Non-steroidal anti-inflammatory drugs (NSAIDs), etc.) to reduce the shoulder pain. Day 2 testing consisted of repeated outcome measures, collected as noted (Cheung et al., 2003) above, VBI screening,

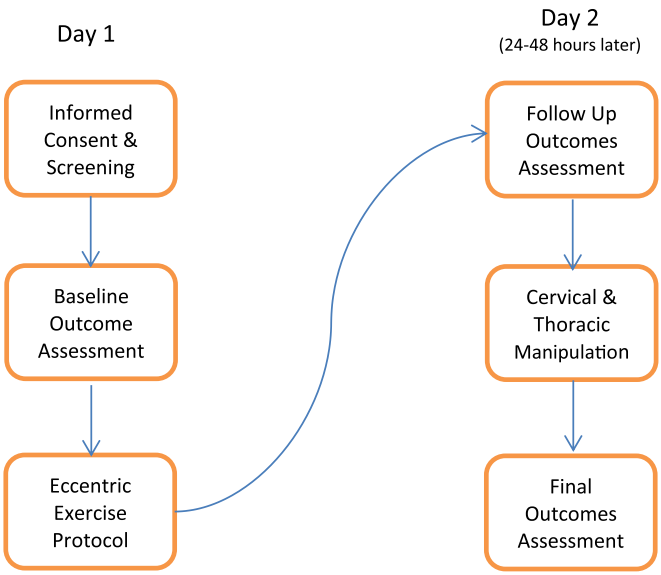

Fig. 1. Participant testing outline.

and the application of cervical and thoracic manipulations. The acute effects of the manipulations were then measured again using the outcomes described. Specific details on all procedures are described below.

2.3. Outcome measures

The self-reported questionnaire used in our study was the SPADI pain scale, which comprises 5 questions referring to the severity of pain experienced in the shoulder. The entire SPADI includes a self-reported disability scale and a self-reported pain scale. The disability scale was not used in this investigation. The entire SPADI has been shown to demonstrate acceptable reliability, internal consistency, validity and responsiveness (Roy et al., 2009). Total score ranges from 0 to 50, with 0 as no pain and 50 as the highest pain score. If there was any presence of pain at baseline (a score other than 0) or if there was no change in SPADI score from baseline, meaning no presence of experimental pain, then the participant was excluded from further testing.

Pain pressure threshold is the minimal amount of pressure required for the sense of pressure to change to pain (Nussbaum and Downes, 1998). A digital algometer (Wagner, Pain Test FP Algometer, Greenwich, CT) with a 1 cm^2 blunt tip was used for testing. Pain pressure threshold was tested over the infraspinatus muscle belly with the participant in prone in the anatomical position. Testing occurred bilaterally as means to determine the systemic effects of the manipulations. The infraspinatus muscle belly was located by palpation inferior to the approximate midpoint of the scapular spine (Fig. 2). When the participant appreciated the vertical force as pain the algometer was removed and the peak force recorded. Standardized procedures for use of the pressure algometer were performed by the same investigator for all measures, with the average of three measurements used for analysis (Nussbaum and Downes, 1998). The time between pain pressure threshold measures was not standardized. Training on pain pressure threshold measurement procedures was performed prior to initiation of the study.

2.4. Experimental pain protocol

Following collection of baseline outcome measurements, participants performed a concentric/eccentric exercise protocol on the

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