Manual Therapy 20 (2015) 540–546

Contents lists available at ScienceDirect

Manual Therapy

journal homepage: www.elsevier.com/math

Original article

Immediate changes in pressure pain sensitivity after thoracic spinal manipulative therapy in patients with subacromial impingement syndrome: A randomized controlled study

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ARTICLE INFO

Article history:
Received 3 July 2014
Received in revised form
26 November 2014
Accepted 10 December 2014

Keywords:
Subacromial impingement
Thoracic manipulation
Pressure pain threshold

ABSTRACT

Background: Thoracic SMT can improve symptoms in patients with subacromial impingement syndrome. However, at this time the mechanisms of SMT are not well established. It is possible that changes in pain sensitivity may occur following SMT.
Objectives: To assess the immediate pain response in patients with shoulder pain following thoracic spinal manipulative therapy (SMT) using pressure pain threshold (PPT), and to assess the relationship of change in pain sensitivity to patient-rated outcomes of pain and function following treatment.
Design: Randomized Controlled Study.
Methods: Subjects with unilateral subacromial impingement syndrome ($n = 45$) were randomly assigned to receive treatment with thoracic SMT or sham thoracic SMT. PPT was measured at the painful shoulder (deltoid) and unaffected regions (contralateral deltoid and bilateral lower trapezius areas) immediately pre- and post-treatment. Patient-rated outcomes were pain (numeric pain rating scale – NPRS), function (Pennsylvania Shoulder Score – Penn), and global rating of change (GROC).
Results: There were no significant differences between groups in pre-to post-treatment changes in PPT ($p \geq 0.583$) nor were there significant changes in PPT within either group ($p \geq 0.372$) following treatment. NPRS, Penn and GROC improved across both groups ($p < 0.001$), but there were no differences between the groups ($p \geq 0.574$).
Conclusion: There were no differences in pressure pain sensitivity between participants receiving thoracic SMT versus sham thoracic SMT. Both groups had improved patient-rated pain and function within 24–48 h of treatment, but there was no difference in outcomes between the groups.
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1. Introduction

Shoulder pain is one of the most common musculoskeletal pain complaints in general medical practice, with a prevalence ranging from 16 to 48% (Pope et al., 1997; Broadhurst et al., 2006). Treatment of shoulder pain with manual therapy techniques that include thoracic spinal manipulative therapy (SMT) is reported to produce positive clinical outcomes (Winters et al., 1997; Bang and Deyle, 2000; Bergman et al., 2004; Boyles et al., 2009; Strunce et al., 2009; Mintken et al., 2010a). Although clinical efficacy is reported with thoracic SMT for the treatment of shoulder pain, the mechanisms underlying the clinical improvements have not been well established. Recent studies have found improvements in patient-rated pain and function after a single treatment of thoracic SMT in patients with subacromial impingement syndrome (SIS), but did not find mechanical changes in thoracic spine or shoulder mobility (Muth et al., 2012; Haik et al., 2014).

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http://dx.doi.org/10.1016/j.math.2014.12.003
1356-689X/Published by Elsevier Ltd.

Pain relief after thoracic SMT may be due to neurophysiologic changes in pain sensitivity at the peripheral and/or central nervous system (Bialosky et al., 2009). Decreased sensitivity to pressure pain (increase in PPT) has been reported after SMT in patients with musculoskeletal pain (Vernon et al., 1990; Fernandez-Carnero et al., 2008; Mansilla-Ferragut et al., 2009; de Camargo et al., 2011; Martinez-Segura et al., 2012). To date, no studies have characterized the neurophysiologic effects of pain sensitivity after thoracic SMT in patients with SIS.

The primary purpose of this study was to assess the effects of thoracic SMT on central and peripheral pain sensitivity measured with PPT in patients with SIS. The secondary purpose of this study was to examine the relationship between change in the pain sensitivity following thoracic SMT and patient-rated outcomes of pain and function. It is hypothesized that patients receiving thoracic SMT compared to sham thoracic SMT will show: 1) increased PPT (decreased sensitivity to pressure pain) at the affected shoulder, indicating a decreased peripheral and/or central sensitivity to pain, 2) increased PPT at regions away from the affected shoulder (unaffected shoulder and over the lower trapezius muscle bilaterally) indicating decreased central sensitivity to pain, and 3) decreased pressure pain sensitivity will be related to improved patient-rated pain and function.

2. Methods

2.1. Participants

Participants (n = 48) with SIS were recruited from local physical and occupational therapy offices, physicians' clinics, as well as by advertisement at a university gym during the period from November 2012 to April 2013. This study took place in a research laboratory in the Physical Therapy Department at Virginia Commonwealth University, and the study protocol was approved by the university's Institutional Review Board. Inclusion criteria for patients with SIS were: 1) pain for ≥6 weeks, 2) typical daily shoulder pain ≥2/10 on an 11-point numeric pain rating scale (NPRS), and 3) 18–60 years of age. Subjects with shoulder pain also had to have 3 of the following 5 clinical signs of SIS: 1) positive Hawkin's Test, 2) positive Neer Test, 3) pain during active elevation >60 in the scapular or sagittal plane, 4) positive Jobe/Empty Can test for pain or weakness, 5) pain or weakness with resisted shoulder external rotation with the arm at the side (Michener et al., 2009). Subjects were excluded from this study if they had 1) a history of shoulder, cervical spine, or thoracic spine surgery, 2) a primary complaint of neck or thoracic pain, 3) signs of central nervous system involvement, 4) signs of cervical nerve root involvement, 5) contraindications to manipulative therapy such as osteoporosis, metastatic disease, or systemic arthritis, 6) adhesive capsulitis, 7) instability of the shoulder, or 8) shoulder or arm pain with cervical rotation to the ipsilateral side, axial compression, or Spurling's Test.

2.2. Procedures

All participants were provided verbal and written explanation of study procedures and signed an informed consent approved by the Institutional Review Board of the university. The participants completed an intake questionnaire (health screening questions, demographic information, and symptom history), a Fear Avoidance Beliefs Questionnaire (FABQ) (Mintken et al., 2010b) a baseline numeric pain rating scale (NPRS) and a baseline Pennsylvania Shoulder Score (Penn) (Leggin et al., 2006).

The NPRS consisted of an 11-point scale ranging from 0 ("no pain at all") to 10 ("pain as bad as it can be"). The NPRS has shown to be reliable and responsive, with a minimal detectable change (MDC) of 2.5 points and a minimal clinically important difference (MCID) of 1.1 points in patients with shoulder pain (Mintken et al., 2009). The baseline NPRS asked patients to "Please rate your shoulder pain at the present time." The NPRS following treatment read: "Now that you have had the manual therapy treatment to your thoracic spine, please rate your shoulder pain." The Penn is a patient-rated shoulder function/disability questionnaire that has been found to be reliable and responsive (Leggin et al., 2006), where scores range from 0 to 100 (100 = no pain or functional loss). The MDC for the Penn is 12.1, and the MCID is 11.4 points (Leggin et al., 2006). Global rating of change (GROC) was assessed following treatment. The GROC is a 15-point scale ranging from −7 (a great deal worse), through 0 (no change), to +7 (a great deal better) and was given at the 24–48 h follow-up to assess change in quality of life following treatment. GROC with an absolute value of 1–3 represent a small change, while change of 4–5 represents moderate change, and change of 6–7 represents large change (Jaeschke et al., 1989).

Upon initiation of testing, baseline PPT measurements were taken at the bilateral deltoid and lower trapezius muscles by an investigator that would remain blinded to treatment group assignments (non-treating investigator). Participants were then randomly assigned to receive thoracic SMT or sham thoracic SMT treatment. Both the thoracic SMT and sham thoracic SMT treatments were administered by a licensed physical therapist with 11 years of orthopedic physical therapy experience (treating investigator). Immediately following the treatment, PPT measures and the NPRS were administered again by the non-treating investigator. At 24–48 h after treatment, participants completed another NPRS and

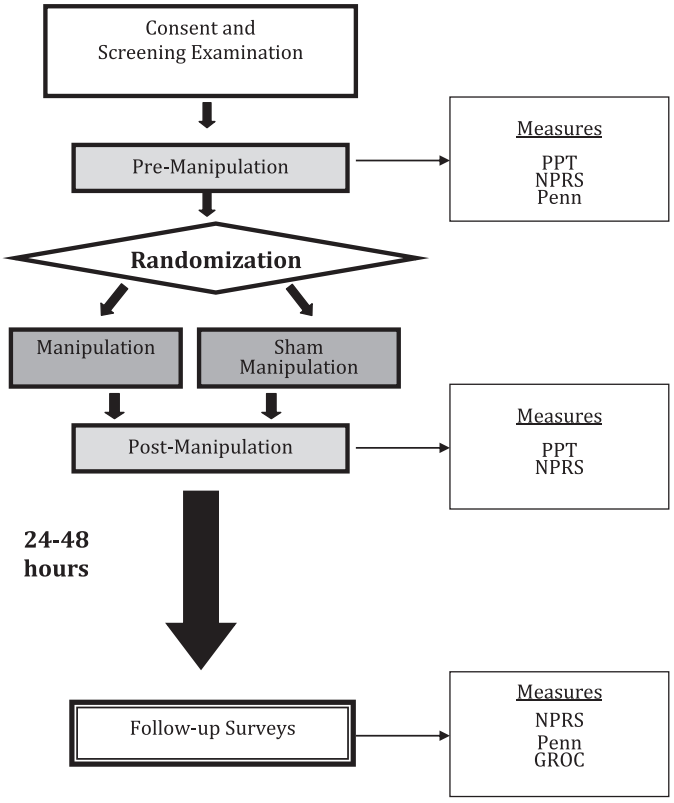

Fig. 1. Flow diagram for experimental procedures. Abbreviations: PPT = Pressure Pain Threshold, NPRS = numeric pain rating scale, Penn = Penn Shoulder Scale, GROC = global rating of change.