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Original article

The effectiveness of thoracic manipulation on patients with chronic mechanical neck pain – A randomized controlled trial

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ABSTRACT

The aim of our study was to assess the effectiveness of thoracic manipulation (TM) on patients with chronic neck pain. 120 patients aged between 18 and 55 were randomly allocated into two groups: an experimental group which received TM and a control group without the manipulative procedure. Both groups received infrared radiation therapy (IRR) and a standard set of educational material. TM and IRR were given twice weekly for 8 sessions. Outcome measures included craniovertebral angle (CV angle), neck pain (Numeric Pain Rating Scale; NPRS), neck disability (Northwick Park Neck Disability Questionnaire; NPQ), health-related quality of life status (SF36 Questionnaire) and neck mobility. These outcome measures were assessed immediately after 8 sessions of treatment, 3-months and at a 6-month follow-up. Patients that received TM showed significantly greater improvement in pain intensity ($p = 0.043$), CV angle ($p = 0.049$), NPQ ($p = 0.018$), neck flexion ($p = 0.005$), and the Physical Component Score (PCS) of the SF36 Questionnaire ($p = 0.002$) than the control group immediately post-intervention. All these improvements were maintained at the 6-month follow-ups. This study shows that TM was effective in reducing neck pain, improving dysfunction and neck posture and neck range of motion (ROM) for patients with chronic mechanical neck pain up to a half-year post-treatment.

1. Introduction

Neck pain is a common musculoskeletal disorder in the general population. In Saskatchewan, Canada, Cote et al. (2000) reported that the age-standardized lifetime prevalence of neck pain was 66.7%. In a telephone survey performed in Hong Kong, Chiu and Leung (2006) reported that the lifetime prevalence of neck pain was 65.4% and the 12-month prevalence was 53.6% (41.0% in male, 59.0% in female). Neck pain is costly in terms of treatment, individual suffering, and time lost to work absentee (Rempel et al., 1992).

Growing evidence has confirmed that the use of manipulation with exercise or the use of mobilization with exercise in treating neck pain has better clinical outcomes than other major and common modalities (Greenman, 1996; Gross et al., 2002; Flynn et al., 2007).

Owing to the intrinsic biomechanical linkage with the cervical spine, disturbances in the biomechanics of the thoracic spine could be a primary contributor to neck pain (Flynn et al., 2007). Flynn et al. (2007) reported that with the use of thoracic manipulation (TM), there was immediate improvement in neck pain. However the lack of comparative group in this trial renders the cause-and-effect relationship inconclusive (Flynn et al., 2007). Many clinicians have intuitively adopted the use of TM to treat neck pain patients, although there is a lack of scientific evidence. Cleland et al. (2005) reported that thoracic spine is the area that is most often manipulated.

There are studies investigating the effect of TM in treating acute and subacute mechanical neck pain (Cleland et al., 2005, 2007a,b; Fernandez-de-las-Penas et al., 2007; Gonzalez-Iglesias et al., 2009a,b), but to date, no studies have investigated the effect in patients with chronic neck pain. In a randomized controlled trial, Cleland et al. (2005) demonstrated an immediate analgesic effect in patients with mechanical neck pain. However the study was limited to a short-term follow-up and the effects on disability and physical impairments e.g. cervical range of motion (ROM) was not evaluated (Cleland et al., 2005).

In contrast, Parkin-Smith and Penter (1998) demonstrated that the combination of cervical and TM did not result in any significant benefit than cervical manipulation alone. Another trial comparing the effect of TM and instructed exercise in the management of neck-

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shoulder pain revealed that there was a statistically significant reduction in the level of perceived worst pain after 12-months follow-up (Savolainen et al., 2004).

As there is a lack of general consensus on the efficacy of TM for patients with neck pain, a well designed trial studying the clinical effects of TM in treating mechanical neck pain with substantial period of follow-up is necessary.

2. Methodology

2.1. Subjects

A sample of 120 patients with a diagnosis of chronic mechanical neck pain by a primary care physician were recruited from an outpatient clinic of the Prince of Wales Hospital and randomly allocated to a TM group (Group A) and a control group (Group B). Patients whose age ranged between 18 and 55 with a diagnosis of mechanical neck pain for more than 3 months were recruited. Patients who had one or more of the following conditions such as: contraindication to manipulation (Gonzalez-Iglesias et al., 2009a,b), history of whiplash or cervical surgery, diagnosis of fibromyalgia syndrome (Wolfe et al., 1990), having undergone spinal manipulative therapy in the previous 2 months or loss of standing balance were excluded from the current study. Explanation and informed consent were obtained from each subject. This study was approved by the ethical review board of the university.

2.2. Randomization

Patients were randomly allocated to the TM group or the control group by using computer-generated minimization method (Jenson, 1991) taking into account of their age, gender, and degree of disability resulting from neck pain. A computer program for randomization was installed in a notebook computer. After a senior physiotherapist keyed in the patients' particulars, the program automatically allocated the grouping of the patient according to the minimization theory that yielded the smallest imbalance between the two groups. The computer-based randomization also helps establish allocation concealment, which is an essential part of a randomized trial. The senior physiotherapist then notified the physiotherapist in-charge for the group allocation of individual patient through a sealed envelope in the patients bed-notes.

2.3. Outcome measures

For the baseline examination and the subsequent follow-ups, each subject reported his/her intensity of neck pain by the verbal Numeric Pain Rating Scale (NPRS) (Jensen et al., 1986) (scale: 0 = no pain–10 = worst pain), which was the primary outcome, and completed two sets of questionnaires [Northwick Park Questionnaire (NPQ) (Chiu et al., 2001) and SF36 health-related quality of life questionnaire (SF36)] as subjective measurements. For objective measurements, subjects' cervical ROM was measured by the Hanoun Multi-Cervical Unit (MCRU) (Chiu and Lo, 2002). The craniovertebral (CV) angle of these subjects was also measured by an Electronic Head Posture Instrument (EHPI) (Lau et al., 2009).

2.4. Sample size calculation

The rationale for calculating the sample size was as follows: From a related study (Chiu et al., 2001) ($N = 90$) using the same questionnaire (NPQ), it was found that the mean and standard deviation of the neck pain score were 13.99 and 5.823, respectively. Assuming that the TM group would improve by 50% and the control group would improve by 25%. Assuming a 0.5 correlation between the pre- and post-measurement, and the standard deviations in the pre- and post-intervention measurement would be about the same, the standard deviation for their difference would be about the same as that of the original measurement (or smaller if the correlation is higher). Using 5% alpha, 90% power, 2-sided alternative test on the difference between pre- and post-measurement, it was estimated that 60 subjects should be required for each group.

2.5. Study design

Group A received TM including 8 sessions (2/week) of infrared radiation therapy (IRR) for 15 min over the painful site. TM (anterior–posterior approach in supine lying) (Gibbons and Tehan, 2000) was given and the level of TM was determined according to clinical assessment (which includes movement analysis and palpation) by an experienced physiotherapist who had post-graduate training in spinal manipulative therapy and with at least 5 years of clinical experience in the management of neck pain patients with manual procedures (Appendix 1). A standard set of educational materials illustrating the simple pathology of neck pain and general advice on neck care was also given. Neck exercises prescribed in the educational pamphlet mainly involve active neck mobilization, isometric neck muscle contraction for stabilization, stretching of upper trapezius and scalene muscles and postural correction exercise. For the mobilization exercises, subjects were instructed to perform 10 repetitions of movement in flexion, extension, side flexion and rotation. For the isometric muscle contractions, subjects were instructed to sustain a contraction in flexion, extension, side flexion and rotation for 5 s and repeat this for 10 repetitions. For the stretching exercise, subjects were instructed to hold a stretched position for 5–8 s for 10 repetitions. All exercises were to be performed daily.

Group B was the control group and received 8 sessions (2/week) of the same IRR treatment together with the same set of educational materials. IRR was suitable as a control intervention as it gives only superficial heating (almost all energy is absorbed at a depth of 2.5 mm) and the effect is not long lasting (Chiu et al., 2005).

All subjects were evaluated and assessed at baseline, immediately after 8 sessions of treatment, at 3-months and at a 6-month follow-up by a blinded assessor.

2.6. Data analysis

Data was analysed with the SPSS package (Version 16.0). The TM group was compared with the control group at the baseline by independent *t*-tests. After the intervention, statistical analysis for the difference (i.e. difference between the pre- and post-measurement) of all outcome measures in both groups were compared by using repeated-measures analysis of variance (ANOVA). The mean difference and their standard deviation were calculated. Moreover, repeated-measures ANOVA was used to investigate whether there was any change after the intervention in each group. Paired *t*-tests with Bonferroni adjustment were adopted for the post-hoc analysis. Between-group effect size was calculated using Partial Eta squared. A p value of less than 0.05 was considered statistically significant.

2.7. Missing data

Some subjects did not return for the follow-up assessments. All of these subjects were contacted again by phone to identify the reason and to determine the treatment effect. The present study adopted the following methods to impute the missing data: (1) For those subjects who failed to attend the follow-up because of