主論文（要約）

研究題名：Immediate effects of thoracic spine self-mobilization in patients with mechanical neck pain: A randomized controlled trial

Nakamaru K, Aizawa J, Kawarada K, Uemura Y, Nitta O

Journal of Bodywork and Movement Therapies 2018 in press

INTRODUCTION

Mechanical neck pain is generally treated conservatively with physical therapy including cervical mobilization and/or manipulation with exercises (Gross et al 2004). In addition, clinical practice guidelines for the management of neck pain patients recommend the use of thoracic spine thrust manipulation (Childs et al 2008). After undergoing thoracic spine thrust manipulation, patients with neck pain are often asked to perform thoracic spine self-mobilization, which improves the mobility of the thoracic spine and thorax, in order to reinforce and maintain the therapeutic effect of the thoracic spine thrust manipulation (Fernández-de-Las-Peñas et al 2011). However, to the best of our knowledge, no previous studies have investigated the effect of thoracic spine self-mobilization alone for mechanical neck pain patients. The purpose of this randomized, controlled trial was to evaluate the immediate effects of thoracic spine self-mobilization alone on disability, pain, and cervical active range of motion in patients with mechanical neck pain.

METHODS

<u>Participants</u>

Consecutive outpatients with mechanical neck pain who were recruited from a rehabilitation department of an orthopedic clinic in Tokyo between June 2015 and December 2016 were screened for eligibility. Inclusion criteria included: (a) age 20 years or older; (b) mechanical neck pain; and (c) a Japanese version of the Neck Disability Index (NDI) score of 15% or greater (7.5 points or greater on a 0-to-50 point scale). Exclusion criteria included: (a) history of a whiplash injury within 2 months; (b) severe thoracic kyphosis; (c) myelopathy; (d) severe cervical radiculopathy; (e) vertebral fracture; (f) history of neck and thoracic surgery; (g) cancer; (h) infection; (i) rheumatism; (j) ankylosing spondylitis; or (k) cognitive disorder. All patients provided their written, informed consent before participation in the study.

<u>Outcome Measures</u>

The primary outcome measure in this trial was the NDI, which is used to assess the level of disability in neck pain patients. The NDI is a condition-specific, self-administered questionnaire that contains 10 items: pain intensity, personal care, lifting, reading, headache, concentration, work, driving, sleeping, and recreation. Each item is scored from 0 to 5, and the total score varies from 0 (no disability) to 50 (totally disabled) (Vernon & Mior 1991). The total score is then converted to a percentage of disability in this study. The psychometric properties of the Japanese version of the NDI have been well documented.

Secondary outcome measures included a visual analog scale (VAS) and active range of motion (ROM) of the cervical spine. The VAS was used to measure the intensity of resting neck pain. Cervical active ROM was measured using a universal goniometer having a full-circle plastic body that has been shown to be reliable, with intra-rater reliability ranging from 0.83 to 0.98 (Farooq et al 2016). Measurements were conducted in the following order: flexion, extension, right lateral flexion, left lateral flexion, right rotation, and left rotation. All outcome measures were collected before and immediately after interventions by four physical therapists, with 4 to 13 years of clinical experience, who were blind to the patients' group allocation.

Randomization procedure and blinding

Prior to starting the trial, a collaborator not involved in data collection created a randomization list with stratified permuted block randomization (block size 4) by sex and age using a computer. An assistant staff member at the rehabilitation department who was not involved in the study was responsible for patient allocation as a third party, and a printed randomization list was stored in a lockable locker located in a room different from that in which evaluation and intervention were performed.

The allocation procedure was as follows: first, the physical therapist responsible for evaluation (hereinafter, evaluating physical therapist) conducted screening and measurement in a treatment space partitioned by a curtain. After obtaining consent from patients who met the eligibility criteria, the sex and age of the patient were communicated to the allocation personnel. The allocation personnel who received this information then communicated the symbol noted on the randomization list to a physical therapist responsible for intervention, who was a different person from the evaluating physical therapist (hereinafter, intervention physical therapist). This intervention physical therapist replaced the evaluating physical therapist and asked the patient to perform the allocated intervention under supervision. After intervention, the evaluating physical therapist replaced the intervention physical therapist for re-evaluation.

Interventions

Thoracic spine self-mobilization

The patients crossed their arms over the chest and sat down on a backless chair with their back against a wall. A physical therapist in charge of intervention put the apparatus involving two tennis balls fixed by athletic tape (Figure 1) between the patient's first and fourth thoracic spinous processes (Johnson & Grindstaff 2012). The patient was asked to perform thoracic spine flexion to the end range in three seconds, and then thoracic spine extension to the end range in three seconds. After ten repetitions of the thoracic spine active flexion-extension movement, the apparatus was placed between the fifth and eighth thoracic spine spinous processes, and the same movements were repeated 10 times (Figure 2-A, 2-B).

Placebo thoracic spine self-mobilization

The patients took the same starting position as for thoracic spine self-mobilization, and they were asked to perform trunk anterior and posterior tilt by hip flexion and extension without spinal movement, taking three seconds for each direction (Figure 3-A, 3-B). This active trunk anterior and posterior tilt movement was done 10 times for two sets.

Statistical analysis

Baseline demographic and clinical variables were compared between two groups using independent t-tests and chi-squared tests. The immediate effect of the intervention (thoracic spine self-mobilization or placebo self-mobilization) was analyzed using two-way repeated measures analysis of variance (ANOVA). If the interaction effects were significant, a simple main effects test was carried out as a post hoc analysis. The Cohen d coefficient was used to determine effect size between groups (Cohen 1998). Effect size was interpreted as follows: d = 0.20 (small), d = 0.50 (medium), d = 0.80 (large) (Cohen 1998). All data analyses were performed with IBM SPSS Statistics Version 22.0 (IBM Corporation, Armonk, NY). The level of significance was set at 0.05.

RESULTS

Sixty-eight neck pain patients were screened for the study, and 16 patients were excluded; 14 patients met the exclusion criteria, and 2 patients refused to participate in the study. Thus, 52 patients (39 females and 13 males) were randomly allocated to the thoracic spine self-mobilization group (n = 25) or the placebo thoracic spine self-mobilization group (n = 27) (Figure 4). No significant difference was found between the two groups for any demographic variables and baseline measures ($p > 0.05$), as shown in Table 1. None of the 52 patients reported any side effects from the interventions.

The results of two-way repeated measures ANOVA indicated that the main effect of time was significant ($p < 0.05$) for all measurement outcomes, and the group × time interactions, which show the difference in improvement between the groups, for cervical flexion active ROM ($F = 8.534$, $p = 0.005$) and extension active ROM ($F = 4.662$, $p = 0.036$) were significant. Conversely, the main effect of group was not significant for all measurement outcomes ($p > 0.05$) (Table 2).

The tests of simple main effect in cervical flexion active ROM (6° [95% CI: 3.7°, 8.3°], $p < 0.0001$) and extension active ROM (5.8° [95% CI: 3.0°, 8.6°], $p < 0.0001$) showed significant differences before and after intervention in the thoracic spine self-mobilization group (Table 3). The between-group effect size of cervical flexion active ROM was large (d = 0.81), and that of extension active ROM was medium (d = 0.55).

DISCUSSION

The purpose of this randomized, controlled trial was to investigate whether intervention with thoracic spine self-mobilization affects the outcome in patients with mechanical neck pain. The study results showed that active ROM in cervical spine flexion and extension improved significantly more in patients with neck pain who carried out thoracic spine self-mobilization than in those who performed placebo thoracic spine self-mobilization.

The results of this study did not show a difference between the groups in the improvement of the VAS or NDI, and only the ROM in cervical spine flexion and extension was significantly improved in the thoracic spine self-mobilization group. It can be postulated from these results that the effect of thoracic spine self-mobilization, an active movement of the thoracic spine, primarily consists of biomechanical effects, such as the improvement of joint ROM and normalization of joint function. Neurophysiological effects, such as pain suppression, appear to be less prominent than such effects observed after passive thrust manipulation.

In the present study, the improvement in ROM was 6.0° for cervical spine flexion and 5.8° for extension after the thoracic spine self-mobilization intervention. Previous studies that examined the immediate effects of thoracic spine thrust manipulation alone without combining with other treatment methods in patients with mechanical neck pain reported that cervical spine flexion improved 2.9-6.6° and cervical spine extension improved 3.2-10.2° after intervention (Casanova-Méndez et al 2014, Suvamnato et al 2013, Martínez-Segura et al 2012). Based on this, it was suggested that intervention by thoracic spine self-mobilization (active movements) in patients with mechanical neck pain produces an effect similar to that of passive intervention with thoracic spine thrust manipulation in improving the ROM in cervical spine flexion.

The ROM in cervical spine flexion and extension alone improved significantly with the thoracic spine self-mobilization used in this trial, and a plausible reason for this is that the thoracic spine plays an essential role in normal mobility of the cervical spine (Crawford & Jull GA 1993, Stewart et al 1995)), and the thoracic spine has a greater involvement during cervical spine movements in flexion and extension than in rotation and lateral flexion (Tsang et al 2013). Moreover, since it is known that decreased thoracic spine mobility poses a risk for the onset of neck pain (Norlander et al 1996), the improvement in thoracic spine mobility through thoracic spine self-mobilization may have increased the involvement of the thoracic spine during active cervical spine flexion and extension. In addition, one of the features of patients with neck pain is decreased angular velocity and angular acceleration of the upper thoracic spine during flexion and extension of the cervical spine (Tsang et al 2013). This is considered to be due to the development of problems with movement coordination and motor control originating from neck pain (Tsang et al 2013). By performing thoracic spine self-mobilization (active movement) and compressing the thoracic spine with the tool used in this study, the proprioceptors of muscles attached from the thoracic spine to the cervical spine can be stimulated, normalizing the muscle and joint functions and improving coordination and motor control during cervical spine movement. This may have consequently increased the ROM in cervical spine flexion and extension. Prior studies have shown that restricted ROM, primarily in cervical spine flexion and extension, is observed in patients with neck pain, as well as those who are currently asymptomatic but have a history of neck pain (Dall'Alba et al 2001, Hagen et al 1997, Lee et al 2004). Thoracic spine self-mobilization improves the ROM of cervical spine flexion and extension, which is likely to become restricted in patients with neck pain, and it therefore appears to be one of the useful treatment methods in these patients.

CONCLUSION

This randomized, controlled trial showed that intervention with thoracic spine self-mobilization in patients with mechanical neck pain has an immediate effect in improving active ROM of cervical spine flexion and extension.

Table 1. Baseline demographics and measurements of patients in both groups

Variables	Self-mobilization group (n = 25)*	Placebo Group (n = 27)*	*P* Value
Sex (male/female) [¥]	6/19	7/20	.873
Age (y) [a]	57 ± 15	62 ± 14	.289
Duration of symptoms (w) [a]	73.2 ± 154.8	46.3 ± 94.5	.450
Neck Disability Index (%) [a]	25.1 ± 8.4	29.4 ± 11.2	.124
Visual Analogue Scale (mm) [a]	38.0 ± 21.2	39.8 ± 24.1	.780
Cervical range of motion (˚) [a]			
Flexion	49.7 ± 11.2	48.3 ± 10.4	.635
Extension	34.8 ± 12.9	39.2 ± 13.4	.239
Right lateral flexion	25.4 ± 7.9	23.9 ± 7.1	.483
Left lateral flexion	24.9 ± 8.5	23.9 ± 8.4	.663
Right rotation	55.6 ± 11.3	51.4 ± 11.5	.187
Left rotation	57.3 ± 10.2	55.4 ± 11.2	.524

* Values are mean ± SD except for sex.

[¥] As determined by chi-squared test.

[a] As determined by independent t-test.

Table 2. Pre-intervention and post-intervention NDI, VAS, and cervical range of motion

Variable	Thoracic self-mobilization (n = 25)*		Placebo self-mobilization (n = 27)*		Main effect : Group (*p*)	Main effect : Time (*p*)	Interaction (*p*)
	Pre	Post	Pre	Post			
NDI (%)	25.1 ± 8.4	20.0 ± 9.3	29.4 ± 11.2	25.7 ± 13.6	0.091	<0.0001	0.453
VAS (mm)	38.0 ± 21.2	32.5 ± 22.6	39.8 ± 24.1	36.5 ± 25.5	0.601	<0.0001	0.142
Active cervical range of motion (˚)							
Flexion	49.7 ± 11.2	55.8 ± 12.6	48.4 ± 10.4	49.6 ± 11.3	0.219	<0.0001	0.005
Extension	34.8 ± 12.9	40.7 ± 11.0	39.2 ± 13.4	40.8 ± 14.9	0.527	<0.0001	0.036
Right LF	25.4 ± 7.9	28.4 ± 9.0	23.9 ± 7.1	25.2 ± 7.1	0.256	0.002	0.181
Left LF	24.9 ± 8.5	28.4 ± 8.4	23.9 ± 8.4	26.1 ± 9.6	0.477	<0.0001	0.327
Right ROT	55.6 ± 11.3	60.4 ± 9.5	51.4 ± 11.5	54.0 ± 11.4	0.077	<0.0001	0.160
Left ROT	57.3 ± 10.2	59.7 ± 9.2	55.4 ± 11.2	57.2 ± 10.0	0.429	0.001	0.625

NDI = Neck Disability Index, VAS = Visual Analogue Scale, LF = lateral flexion, ROT = rotation.

* Values are expressed as means±SD for pre-intervention and immediate post-intervention data.

Table 3. Simple main effects test

Measures	Within-Group Change Scores *	*P* value
Cervical flexion (°)		
Thoracic spine self-mobilization	6.0 (3.7, 8.3)	<0.0001
Placebo self-mobilization	1.1 (-1.0, 3.5)	0.268
Cervical extension (°)		
Thoracic spine self-mobilization	5.8 (3.0, 8.6)	<0.0001
Placebo self-mobilization	1.6 (-1.1, 4.3)	0.244

* Values are expressed as means (95% confidence interval) for within-group change scores.

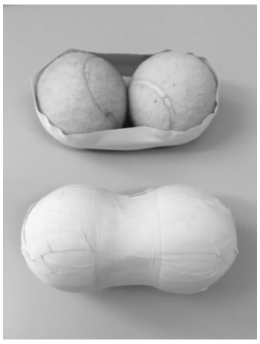

Figure 1. The thoracic spine self-mobilization tool made by two tennis balls fixed by athletic tape

Figure 2. Thoracic spine self-mobilization. Thoracic spine flexion (A), and thoracic spine extension (B).

Figure 3. Placebo thoracic spine self-mobilization. Trunk anterior tilt (A), and trunk posterior tilt (B).

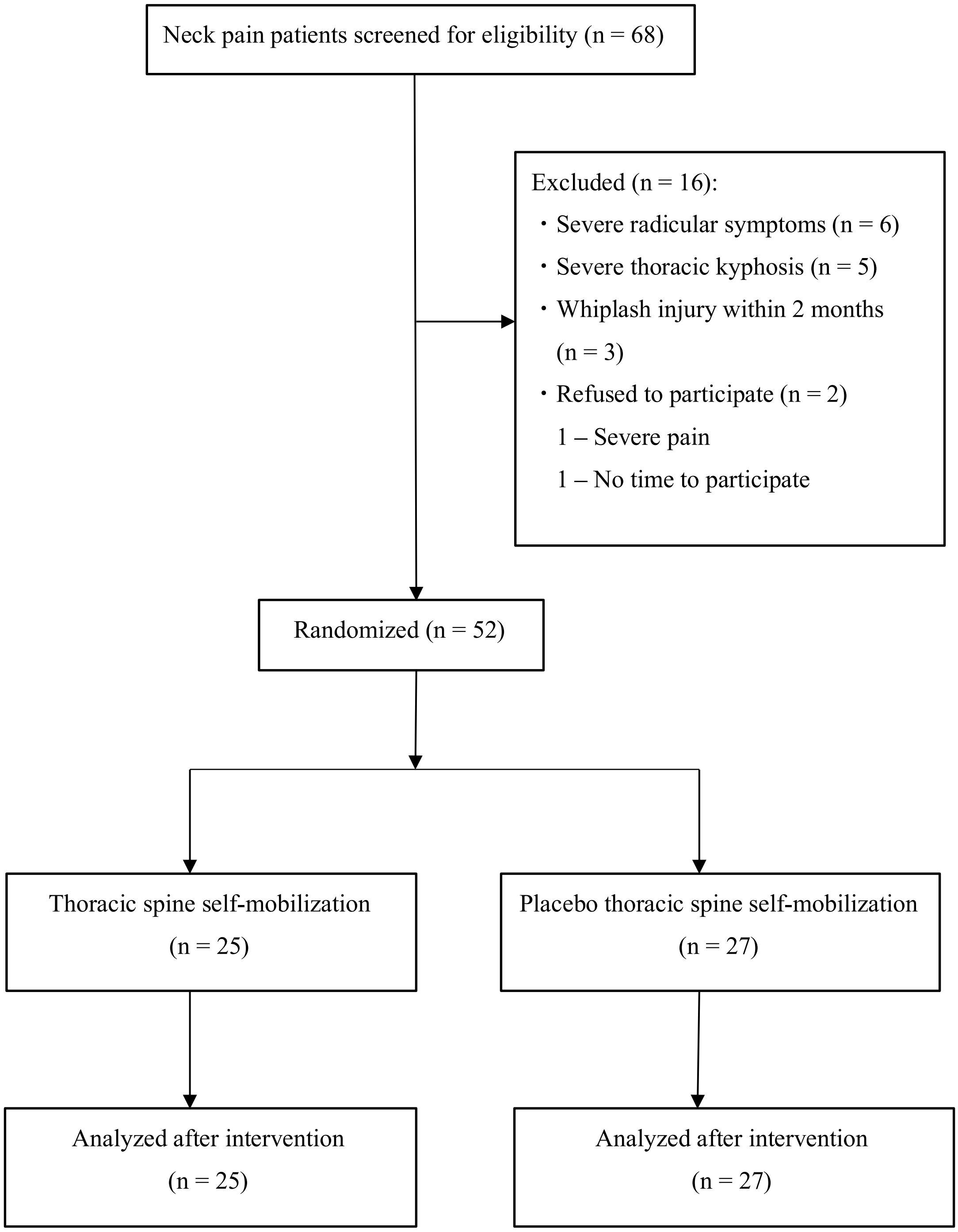

Figure 4. Flow-diagram of subject selection and randomization