A Comparison Between the Effects of Scapulothoracic Mobilization Plus Physical Therapy With Physical Therapy Alone in Patients With Mechanical Neck Pain: A Randomized Clinical Trial

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ABSTRACT

Objective: The purpose of this study was to compare the effects of scapulothoracic (ST) mobilization plus physical therapy (PT) with PT alone in patients with mechanical neck pain.

Methods: This double-blinded randomized clinical trial was conducted at Shiraz School of Rehabilitation Sciences and involved 46 patients with mechanical neck pain and scapular dyskinesia. The patients were randomly assigned to the ST mobilization + PT group (scapulothoracic mobilization and physical therapy) or the PT group (physical therapy treatment) by a computer-generated randomized table of numbers. Both groups received 5 sessions of treatment during 1 week. Pain intensity and grip strength were evaluated 3 times: baseline, after the first session, and after the fifth session. Furthermore, functional disability of the upper limbs and the neck were evaluated before and at the fifth session.

Results: The results showed that the pain intensity was reduced and grip strength increased significantly after the first session ($P = .01$) and at the end of the treatment ($P = .01$) in the ST mobilization + PT group in comparison with the PT group. Also, the mean difference of upper limb ($P = .01$) and neck disability ($P = .02$) decreased significantly in the ST mobilization + PT group in comparison with the PT group.

Conclusion: Scapulothoracic mobilization in combination with physical therapy may be superior to physical therapy alone in reducing pain intensity, maximizing grip strength, and reducing upper limb and neck disability in mechanical neck pain. (J Chiropr Med 2018;17:237-243)

Key Indexing Terms: *Scapula; Neck Pain; Disability Evaluation*

INTRODUCTION

Background

Neck pain is a common disorder that can lead to disability and high expenses, such as absenteeism from work and decreased wages and productivity.¹⁻³ Most people experience neck pain at least once in their lifetime. Previous studies have shown that 67% of patients with mechanical neck pain have symptoms in the upper

extremities without any sign of a neurological disorder.⁴ Functional limitations (such as inability to rotate the head and neck) were demonstrated in patients with neck pain.⁵

The scapula plays an important role in providing both mobility and stability of the neck and shoulder region. Szeto et al (2002) showed altered postural behavior during prolonged sitting tasks in patients with neck pain.⁶ A slouched posture and increased curvature of the cervical and thoracic regions may affect the scapular orientation and shoulder muscle strength.⁷⁻⁹ When the position is maintained for a long period, it increases the muscle length and subsequently structural weakness of the related muscles.¹⁰ Therefore, the scapula may be influenced by abnormal alignment of the cervical joints, causing neck pain. Furthermore, some studies have shown scapulothoracic (ST) muscle impairment, including middle trapezius, rhomboids,¹¹ lower trapezius,¹² and serratus anterior,^{13,14} in patients experiencing neck pain. Scapulothoracic muscles play a critical role in load transfer between the upper extremities and the vertebral column.^{15,16} Any disorder in

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ST muscle function can lead to excessive mechanical strain. Consequently, shared muscle attachments between the scapula and the cervical spine apply a load to pain-sensitive cervical spine structures.^{15,16} In addition, Kim et al¹⁰ showed that scapular asymmetry is directly related to neck pain based on the left–right differences in the distance between the thorax and scapula. Hence, abnormal scapular position and any related changes in ST muscle activity may affect the cervical joints, causing neck pain. Based on this evidence, scapular treatments are considered as part of intervention in patients with chronic neck pain.^{17,18}

The clinical procedures on physical therapy have suggested that manual therapy interventions (thoracic manipulation and mobilization, cervical manipulation and mobilization, and massage) should be considered in patients with neck pain.^{19–22} Scapulothoracic mobilization is a manual technique used to treat musculoskeletal disorders, including neck or shoulder disorders.

A few studies have investigated the effects of ST mobilization in patients with shoulder dysfunctions.^{14,15} Surenkok et al¹⁴ revealed that 1 session of ST mobilization can cause improvement in the shoulder range of motion, scapular upward rotation, and pain intensity in patients with painful shoulder dysfunction. Celenay et al (2016) suggested that cervical and ST stabilization exercises with cervical and scapular mobilization may be superior to stabilization exercises alone for improving disability, pain intensity at night, cervical rotation motion, and quality of life in patients with neck pain.²³ Although the study of Celenay et al (2016) showed positive effects of stabilization exercises with manual therapy in the improvement of patients with mechanical neck pain, there was a lack of a randomized clinical trial to investigate the true treatment effects of scapula mobilization in patients with mechanical neck pain. Therefore, this study aimed to investigate the effects of ST mobilization on pain intensity, disability level, and grip strength in patients with mechanical neck pain.

METHODS

Trial Design

This study was a double-blinded randomized controlled trial registered at the Iranian Registry of Clinical Trials (IRCT2014100119358N1).

Participants

Forty-six mechanical neck pain patients with scapular dyskinesia participated in this study. Mechanical neck pain was diagnosed by physical examination, which began with visual and static observation, followed by a neurological examination consisting of dermatomal, myotomal, and reflex testing from C5 to T1 to rule out cervical radiculopathy. Orthopedic tests, including the distraction test, Spurling test, and upper-limb tension test (median

nerve) also were performed. To determine the presence of dyskinesia, the medial and superior borders of the scapula were evaluated during arm elevation using a yes–no method (yes: the presence of 1 or more dyskinetic patterns, no: a normal motion).

The inclusion criteria were participants between 20 and 50 years of age, mechanical neck pain without any signs of radicular pain in the upper extremities,^{24,25} Neck Disability Index 10% to 45%, a history of neck pain within the last 3 months, and having scapula dyskinesia based on a yes–no method.^{16,26} The exclusion criteria were any of the following disorders: history of whiplash injury or neck trauma, history of rheumatoid disease or osteoarthritis in the upper- extremity joints, neurologic disorders (stroke, multiple sclerosis, etc), and peripheral nervous system disorders (neuropathies, carpal tunnel syndrome, Guyon's canal syndrome, or cervical radiculopathy). The study was performed in the physiotherapy clinic at the School of Rehabilitation Sciences of Shiraz University of Medical Sciences (Shiraz, Iran).

Randomization

The patients were assigned randomly to the ST mobilization + PT group or to the PT group using a computer-generated randomized table of numbers. This random list was provided by a researcher who was not aware of the treatment process. Then, the researcher assigned a number to each participant that then was folded and placed in an opaque, sealed envelope. Before the interventions, 1 physical therapist was considered as the evaluator of PT. The evaluator physical therapist performed all measurements before and after the interventions. A second physical therapist was considered as treating physical therapist. The treating physical therapist with at least 5 years of clinical experience in the field of manual therapy performed all treatments for this study. The evaluator physical therapist and patients were blinded to the group allocations. However, it was not possible to blind the patients or treating therapist owing to the nature of the interventions.

Interventions

Patients with mechanical neck pain who were referred to the physiotherapy clinic at the School of Rehabilitation Sciences of Shiraz University of Medical Sciences were recruited through advertisement on the university bulletin board. Before their participation, all participants signed a written informed consent, approved by the ethics committee of Shiraz University of Medical Sciences. The patients were allocated randomly into 2 groups: PT group (routine PT, 5 sessions during a week, for 2 weeks), and ST mobilization group (routine PT in addition to ST mobilization technique).

Physical Therapy

Treatment involved physical modalities and isometric neck exercises. Physical modalities included hot pack and transcutaneous electrical nerve stimulation (Novin, Newdyn 620F, Tehran, Iran), where the electrodes were placed bilaterally on each side of the spinous process of the C7 vertebra at a frequency of 100 Hz (250-microsecond pulses) for 20 minutes during each session.

Isometric exercises were done in a sitting position. Isometric contraction with maximal intensity was held for 6 seconds with 20 repetitions. The exercises included flexion in which the patient had to place both hands on their forehead and press it into their palms in a nodding form. Next, we did side bending in which the patients pressed 1 hand against 1 side of their head and tried to side bend without actually bending. Then, in axial extension, the patients pressed the back of their head into both hands, which was bent backward.²⁰ All patients were treated by the same expert physical therapist.

Scapular Mobilization (ST)

Patients lay on their intact side on a bed while their hip and knee joints were flexed. The therapist stood in front of the patient, placing her index finger of 1 hand under the medial scapular border and the inferior angle of the scapula was in the web space; the other hand grabbed the superior border of the scapula. The scapula was moved superiorly and inferiorly for superior and inferior glide, and medially and laterally for medial and lateral glide, and then the scapula was rotated upward and downward for scapular rotation. The techniques sustained and applied with grade 4. Ten sets of 10 repetitions were applied with 30 seconds' rest between each set. Every movement was held for 5 seconds and there was 3 seconds' rest between each movement in each set. They also received 5 sessions of scapula mobilization for a week.^{14,15}

OUTCOMES

Pain Intensity

Pain intensity was evaluated with the Pain Numeric Rating Scale. This scale ranges from 0 to 10, where 0 means no pain and 10 indicates severe pain.²¹ All patients were evaluated at the baseline, after the first session, and after the fifth session by a blinded assessor.

Disability Assessment

Functional disability of the upper limb and the neck were evaluated by Disabilities of Arm, Shoulder and Hand Questionnaire²² and Neck Disability Index, respectively. These assessments were done at the baseline and after the fifth session.

Grip Strength

Maximum grip (MG) strength was measured with a digital dynamometer (MIE Medical Research, Leeds, United Kingdom. This instrument is reliable and valid.²⁷ To standardize the test conditions, the participants sat on a chair without an arm support with hips and knees in 90° flexion, shoulder in adduction and neutral rotation, elbow at 90° flexion, and the forearm and wrists in a neutral position. Then, they grasped the instrument's handle. The MG test was performed 3 times with 20 seconds of rest interval between each measurement. Mean MG strength was calculated at the baseline, after the first session of treatment, and after the fifth session.

Sample Size Determination

The sample size calculation was performed using Power SSC. The calculations were based on detecting differences of 7.4 degrees based on the range of motion data, assuming a standard deviation of 8 (data taken from Van Dillen et al²⁴), an α level of 0.05, and a power of 80%. The sample size was estimated at 19 women in each group. By predicting the 20% dropout rate, we recruited 23 women in each group.

Statistical Methods

The statistical analyses were performed using the Statistical Package for Social Sciences, version 19.0 (IBM Corp, Armonk, New York). The data normality was checked by Kolmogorov-Smirnov test. The data were normally distributed with the exception of functional disability of the upper limbs and neck. Hence, nonparametric tests were used to analyze the data. Within-group and between-group comparisons of functional disability of the upper limbs and neck were calculated by Wilcoxon and Mann-Whitney tests, respectively. Also, the analyses of grip strength and pain intensity were performed using 2-way mixed analyses of variance.

RESULTS

Forty-six patients were recruited and screened for group assignment (Fig 1). Baseline variables were not significantly different between the groups ($P > .05$; Table 1). The analysis of pain intensity revealed that there were significant differences in group $\times$ time interaction and main effect of time $\times$ time interaction (Table 2). Post hoc analysis of time showed that pain intensity significantly decreased at the baseline and in the first session, baseline and fifth session, and first to fifth session. Also, the group $\times$ time interaction was significant at the first session ($P = .01$) and fifth session ($P = .001$; Fig 2).

On the other hand, the 2-way mixed analysis of variance showed that the main effect of time and group $\times$

Fig 1. Flow diagram of the study.

time interaction was significant in maximum grip strength (Table 2). Pairwise comparisons of time showed that maximum grip strength significantly increased in the baseline and first session and baseline and fifth session. The interaction of group by time was significant only at the fifth session ($P = .008$; Fig 3).

In addition, the results showed that upper limb and neck disability significantly decreased after the fifth session in comparison with baseline only in ST mobilization + PT group. Also, between-groups comparisons showed that the mean difference of the upper limb ($P = .01$) and neck disability ($P = .02$) was significantly

Table 1. Baseline Characteristics of the Patients With Mechanical Neck Pain in 2 Groups

	PT Group (N = 23)	ST Mobilization + PT Group (N = 23)	P Value
Female (n)	23	23	
Age (y)	39.13 (10.50)	39.82 (10.12)	.82
Height (cm)	158.65 (9.54)	159.73 (8.59)	.51
Weight (kg)	59.56 (7.66)	62.78 (9.29)	.20
BMI (kg/m ²)	23.71 (3.26)	24.55 (3.11)	.37

BMI, body mass index; PT, physical therapy; ST, scapulothoracic.
Values are mean (standard deviation) for baseline variables.

Table 2. Summary of Analysis of Variance for Pain Intensity and Maximum Grip Strength

Independent Variables	Pain Intensity		Maximum Grip Strength	
	F Ratio	P Value	F Ratio	P Value
Time	77.00	<.001 ^a	7.67	<.001 ^a
Group	3.94	.05	1.09	.30
Time × group	14.65	<.001 ^a	5.00	.009 ^a

^a Indicates significant differences ($P < .05$).

improved in the ST mobilization + PT group compared with the PT group (Table 3).

DISCUSSION

The results of our study showed that ST mobilization combined with physical therapy can result in a significant decline in pain intensity compared with merely physical therapy in mechanical neck pain patients with scapular dyskinesia. Our finding is consistent with the results of Surenkok et al¹⁴ that reported a single session of scapular mobilization can cause improvement in pain intensity. It seems that reduced pain intensity is due to the effects of ST mobilization technique.^{28,29} For the neurophysiologic process, mobilization technique inhibits the transmission of nociceptive inputs to the central nervous system owing to stimulation of the peripheral mechanoreceptors.^{25,30} Scapular dyskinesia applies a compressive load on the cervical vertebrae. This could be due to abnormal weight transfer of the cervicoscapsular muscles between the upper limbs and neck.²⁶ In addition, the upper portion of the cervicoscapsular muscles, such as the trapezius and levator scapula, can apply a destructive load to neck structures.^{24,26,31} Scapular mobilization technique can reduce the compressive load, and posterior shearing of the cervical structures, which

ultimately leads to pain relief by reducing passive stretching on the cervicoscapsular muscles.²⁴

In addition, our findings showed that upper limb and neck disability were significantly reduced in the intervention group compared to the PT group. These findings are consistent with those of Yang et al¹⁵ and Surenkok et al.¹⁴ They reported that scapular mobilization technique reduced the disability index in patients with shoulder dysfunction. This effect can be explained by 2 mechanisms. First, ST mobilization may increase the scapular motion and reduce the upper limb disability. One of the limitations in the present study was lack of evaluation of the scapular range of motion, but we stated that mobilization technique improves extensibility by stretching of the tightened soft tissues. As a result, it can improve the range of motion and function of adjacent structures.^{32,33} Second, ST mobilization technique can decrease the adhesiveness of the muscles around the scapula.¹⁴

Scapulothoracic muscles play a critical role in load transferring between the upper extremities and the vertebral column.^{8,9} Therefore, improvement in the ST muscles' function can reduce the mechanical stress and lead to appropriate load distribution in the cervical spine.

Furthermore, this study suggests that ST mobilization with physical therapy can increase the grip strength compared to physical therapy treatment alone. Grip strength is a variable measure for evaluating hand function and strength.⁴² Therefore, increased grip strength could be another possible

Fig 2. The interaction effects of group and time with its standard error bars for pain intensity. The significant results are shown with an asterisk.

Fig 3. The interaction effects of group and time with its standard error bars for grip strength. The significant results are shown with an asterisk.

Table 3. Results of Within- and Between-Group Comparisons for Primary and Secondary Outcome Measures

Outcome Measures	Functional Disability of Upper Limb (%)		Functional Disability of Neck (%)	
	Pre	Post	Pre	Post
PT group (N = 16)	29.31 (10.18-71.29)	30.83 (3.70-58.33)	24.00 (12.00-45.00)	22.00 (10.00-39.00)
ST mobilization + PT group (N = 23)	35.00 (14.65-79.16)	20.00 ^a (4.31-79.16)	30.00 (16.00-45.00)	18.00 ^a (6.00-44.00)
<i>P</i> value between group		.01 ^b		.02 ^b

PT, physical therapy; ST, scapulothoracic.
Values are median (range).

^a Indicates significant differences ($P < .05$).

^b Values indicate a significant ($P < .05$) pre-post intervention change (within-group comparison).

explanation for reduced upper limb disability after ST mobilization technique.

A treatment program that includes ST mobilization and physical therapy may be more beneficial than physical therapy alone for patients with mechanical neck pain.

This research provides new insights into the importance of a holistic approach to neck pain treatment and helps us to understand the relationship between neck pain and scapular dysfunction.

Limitations and Future Studies

The current study was conducted among a female population with neck pain from a low to moderate level of functional disability (disability of 10% to 45%). Consequently, these results cannot be generalized for the general neck pain population. Other limitations of this study were the short-term data collection, low sample size, and lack of follow-up sessions. Furthermore, it was not possible to blind treating physical therapists owing to the nature of the interventions. Some of these methodological faults should be improved in future research.

Future studies are recommended to provide useful information regarding the activated muscles with 3-dimensional scapular kinematic analysis and the EMG signal during mobilization. Investigating scapular movements, along with muscle activity during mobilization, would provide additional information.

CONCLUSION

Scapulothoracic mobilization with physical therapy may be superior to physical therapy alone to reduce pain intensity, maximize grip strength, and reduce upper limb and neck disability in mechanical neck pain with dyskinesia.

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Practical Applications

- Scapulothoracic mobilization with physical therapy may be superior to physical therapy alone in reducing pain intensity, maximizing grip strength, and reducing upper limb and neck disability in mechanical neck pain.
- Scapulothoracic mobilization should be considered as part of a rehabilitation program for patients with neck pain.

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