J. Phys. Ther. Sci. 28: 743–746, 2016

The Journal of Physical Therapy Science

Original Article

The initial effects of an upper extremity neural mobilization technique on muscle fatigue and pressure pain threshold of healthy adults: a randomized control trial

Myoung-Kwon Kim, PT, PhD[1)], Hyun-Gyu Cha, PT, PhD[2)*], Sang Gu Ji, PT, PhD[3)]

[1)] Department of Physical Therapy, College of Rehabilitation Sciences, Daegu University, Republic of Korea
[2)] Department of Physical Therapy, College of Kyungbuk: 77 Daehak-ro, Yeongju, Gyeongsangbuk-do 750-712, Republic of Korea
[3)] Department of Physical Therapy, Eulji University Hospital, Republic of Korea

Abstract. [Purpose] The purpose of this study was to determine the effects of an upper extremity neural mobilization technique on delayed onset muscle soreness. [Subjects] Forty-five healthy subjects were randomly assigned to two groups: a nerve mobilization group (experimental) and a control group. [Methods] The subjects of the experimental group were administered a median nerve mobilization technique and ultrasound for the biceps brachii muscle. The subjects in the control group were only administered ultrasound for the biceps brachii muscle. Muscle fatigue and the pressure pain threshold were assessed before and after the intervention. [Results] The experimental group showed significant improvements in all variables, compared to pre-intervention. Furthermore, the control group showed significant improvements in the pressure pain threshold, compared to pre-intervention. Significant differences in the post-intervention gains in muscle fatigue and pressure pain threshold were found between the experimental group and the control group. [Conclusion] Application of the upper extremity neural mobilization technique is considered to have a positive effect on recovery from delayed onset muscle soreness.

Key words: Neural mobilization, Muscle fatigue, Pressure pain threshold

(This article was submitted Sep. 16, 2015, and was accepted Nov. 25, 2015)

INTRODUCTION

Delayed onset muscle soreness (DOMS) refers to the occurrence of inflammatory responses after primary micro-damage of the muscles. Chemicals such as histamine, bradykinin, and prostaglandin are released in the regions with pain, and osmotic pressure increases due to increased permeability within the muscles. For this reason, type III and IV afferent nerve fibers are activated, signaling pain to the central nervous system[1)]. DOMS is clearly shown in the muscle belly and the musculotendinous junction, and it begins to be expressed within 12 to 24 hours after eccentric exercises, peaking within 48 to 72 hours post-exerciese[2)]. Physical therapies for the prevention of DOMS include nerve mobilization, ultrasound, electrotherapy, ice, and vibration. Among them, ultrasound is a treatment tool that is commonly used for musculoskeletal diseases, and it elicitis various biological effects in the soft tissues through heat or specific heat[3)]. Nerve mobilization techniques are performed to reduce nerve mechanosensitivity and increase the compliance of nerve tissues by increasing neural flexibility[4)].

In recent years, most studies of nerve mobilization techniques have been conducted using patients with peripheral nervous system disorders, and few studies have attempted to reduce DOMS. Therefore, the purpose of this study was to understand the effects on DOMS of an upper extremity neural mobilization technique combined with ultrasound after the induction of DOMS in the biceps brachii muscle.

*Corresponding author. Hyun-Gyu Cha (E-mail: niceguy-chatty@hanmail.net)

SUBJECTS AND METHODS

This study selected forty-five healthy people with no orthopedic history and was conducted after their consent to participation in this study had been obtained. The subjects were not currently experiencing any neck or dominant upper extremity symptoms, had no significant history of a chronic painful condition, and were not using pain-relievers. All the experimental procedures were reviewed and approved by the Institutional Ethics Committee of Eulji University Hospital. The forty-five healthy subjects were randomly assigned to two groups: a nerve mobilization group (experimental) and a control group. For randomization, sealed envelopes were prepared in advance and marked inside with A or B, indicating the experimental group or the control group. The randomization was done by a third party who was unaware of the study content. The subjects' characteristics and all outcome measures before and after the treatment were assessed by Physician 1, who was blinded to the treatment allocations. The intervention was administered in a closed room by Physician 2, who was not involved in the assessment of the subjects. Both physicians were instructed not to communicate with the subjects about the possible goals or the rationale of either treatment.

The general characteristics of the subjects of this study are shown in Table 1. DOMS was induced in the biceps brachii muscle of the subjects on the non-dominant side so as not to disturb their daily activities. The subjects were instructed to hold a dumbbell, which weighed 70% of their maximum isometric strength, while fixing their trunk and shoulders, and to maintain the elbow joint at 90° for one second, and then slowly lower the dumbbell for three seconds. After the elbow joint had completely extended, the tester flexed the subject's elbow joint at 90° again. The subjects had to perform this motion 15 times as a set, and five sets in total. After finishing each set, a one-minute break was provided[5)].

The subjects in the experimental group received ultrasound and a neural mobilization technique, each for 10 min. The subjects in the control group only received ultrasound for 10 min. After DOMS was induced, all the subjects were treated with ultrasound (Ultra Combi 707, Daeyang Medical, Korea).

Subjects received ultrasound while lying comfortably on a bed. Ultrasound was applied to the biceps brachii muscle for 10 minutes at a frequency of 1 MHZ and an intensity of 1.0 W/cm^2. An upper-extremity neural mobilization technique was additionally administered to subjects in the experimental group[3)]. This technique was performed sequentially using a five-stage application method for the relaxation of the biceps brachii muscle. The neural mobilization technique for the median nerve was performed similar to those reported in the literature[4)]. The participant was positioned supine and the cervical spine was positioned in approximately 25°of contralateral lateral flexion, or when the first sense of increased resistance was perceived by the investigator, whichever occurred first. This was followed by the following consecutive positioning procedures: (1) the application of passive scapular depression until a sense of resistance was perceived by the investigator; (2) 90°of combined shoulder abduction and external rotation combined with forearm supination, wrist extension, finger extension until a sense of resistance was perceived by the investigator; (3) elbow extension was then applied until a sense of resistance was perceived by the investigator, or when shoulder girdle elevation was noted. This process was repeated eight times. The final posture was maintained for 20 seconds, and it was repeated 12 times. This process was performed for 10 minutes within the degree that did not cause a sense of discomfort in the subjects[4)].

A lactate analyzer, Accutrend (RDGH, Germany), was used to measure lactic acid in the blood. Blood was collected from capillary vessels of the end of the second finger using a capillary tube, and was then analyzed. In addition, a digital pressure pain threshold measuring instrument, The Digital Pain Evaluating System (ZEVEX Co, USA), was used to determine changes in pressure pain threshold. This device measured the blood generated when the pressure pain threshold measuring instrument was vertically placed over the muscle belly of the biceps brachii and applied pressure.

Before therapy, differences in the general characteristics of the experimental group and the control group were compared using the independent t-test for age, height and weight, and the χ^2 test for gender. Comparisons of the variables before and after the training within each group were made using the paired-samples t-test. Comparisons of pre- and post-test differences in variables between the experimental group and the control group were done using the independent t-test. The statistical software SPSS 20.0 (SPSS, Chicago, IL, USA) was used for the statistical analysis. The level of significance was chosen as 0.05.

RESULTS

The experimental group showed significant improvements in all variables, compared to pre-intervention results ($p<0.05$). Furthermore, the control group showed significant improvements in the pain pressure threshold, compared to pre-intervention ($p<0.05$). Significant differences in the post-intervention gains in muscle fatigue and pain·pressure threshold were found between the experimental group and the control group ($p<0.05$) (Table 2).

The effect sizes for gains in the experimental and control groups were very strong for muscle fatigue and pressure pain threshold (effect size= 0.73, 0.80 respectively).

Table 1. General characteristics of the subjects

	EG (n=22)	CG (n=23)
Gender (male/female)	12/10	9/14
Age (years)	21.4±2.2[a]	20.4±1.5
Height (cm)	168.5±6.3	170.5±10.1
Weight (kg)	60.1±11.3	63.4±6.5

[a]Mean±SD, EG: Ultrasound + Neural mobilization technique, CG: Ultrasound

Table 2. Comparison of muscle fatigue and pressure pain threshold between pre- and post-intervention, and between groups

	EG (n=22)	CG (n=23)
Muscle fatigue (mol/dl)		
Pre-intervention	7.35±5.85[a]	6.30±5.28
Post-intervention*[b]	3.44±3.07*	5.93±2.96
Change value*	3.91±5.56	0.37±6.33
Pain·pressure threshold (lb)		
Pre-intervention	22±2.36	23±3.85
Post-intervention*[b]	19±3.14**	22±4.12*
Change value*	3±1.23	1±0.58

[a]Mean±SD, EG: Ultrasound + Neural mobilization technique, CG: Ultrasound
Values are expressed as mean±SD, *$p<0.05$, **$p<0.01$
[b]Effect size greater than 0.70

DISCUSSION

This study induced DOMS in the biceps brachii muscle of normal individuals, and after applying an upper-extremity neural mobilization technique combined with ultrasound, it examined the treatment effects on the concentration of lactic acid in the blood and pressure pain threshold. The results show the treatment's effectiveness at reducing the concentration of lactic acid and pressure pain threshold. Cowell and Phillips[6] reported in their study that a neural mobilization technique reduced problems with nerve conduction caused by damage to the nervous system, and improved flexibility in the structure of the nervous system and muscles, thereby helping to relieve sensory or motor disorders. Moreover, their study exhibited a similar pattern to the results of the present study in terms of reducing the secretion of lactic acid and reducing pain due to enhanced blood circulation.

The therapeutic mechanism of nerve mobilization techniques facilitates nerve conduction by improving axonal transport and increasing blood flow by reducing pressure within the nerves[4, 7]. This is effective at reducing muscular pain due to musculoskeletal diseases and elevated concentrations of lactic acid in the blood[7–9]. Therefore, the results of this study suggest that the continuous application of a neural mobilization technique for shortened muscle tissues can prevent the accumulation of lactic acid within the muscles by increasing the extensibility of nerve roots, and can reduce pain by blocking the signaling of nerve fibers with pain to the midbrain-thalamus. The limitations of this study were as follows. First, this study involved healthy people and it is therefore difficult to generalize the results to all populations. Second, the absence of a follow-up after the end of the nerve mobilization did not allow the determination of the durability of the effect of this therapy. Further studies, including a long-term follow-up assessment, are needed to evaluate the long-term benefits of nerve mobilization. Future studies should also suggest standardized application methods for nerve mobilization techniques and continue to research nerve mobilization techniques combined with interventions for various musculoskeletal diseases.

REFERENCES

1) Clarkson PM, Hubal MJ: Exercise-induced muscle damage in humans. Am J Phys Med Rehabil, 2002, 81: S52–S69. [Medline] [CrossRef]
2) Colby KC: Therapeutic exercise. Philadelphia: FA Davis, 2002.
3) Aytar A, Tuzun EH, Eker L, et al.: Effectiveness of low-dose pulsed ultrasound for treatment of delayed-onset muscle

soreness: a double-blind randomized controlled trial. Isokinet Exerc Sci, 2008, 16: 239–248.
4) Schmid AB, Brunner F, Luomajoki H, et al.: Reliability of clinical tests to evaluate nerve function and mechanosensitivity of the upper limb peripheral nervous system. BMC Musculoskelet Disord, 2009, 10: 11–15. [Medline] [CrossRef]
5) Behm DG, Baker KM, Kelland R, et al.: The effect of muscle damage on strength and fatigue deficits. J Strength Cond Res, 2001, 15: 255–263. [Medline]
6) Cowell IM, Phillips DR: Effectiveness of manipulative physiotherapy for the treatment of a neurogenic cervicobrachial pain syndrome: a single case study—experimental design. Man Ther, 2002, 7: 31–38. [Medline] [CrossRef]
7) Butler DS: The sensitive nervou system. Noigroup Publications, 2000.
8) Kim MK, Ji SG, Cha HG, et al.: Effects of electromagnetic diathermy in conjunction with nerve mobilization in the management of lower back pain. J Phys Ther Sci, 2012, 24: 1337–1339. [CrossRef]
9) Cha HK, Cho HS, Choi JD: Effects of the nerve mobilization technique on lower limb function in patients with post-stroke hemiparesis. J Phys Ther Sci, 2014, 26: 981–983. [Medline] [CrossRef]