



Original Article

Immediate effects of neuromuscular joint facilitation treatment on vertebral artery blood flow

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Abstract. [Purpose] The purpose of this study was to investigate the changes in blood flow velocity and the vascular diameter of vertebral arteries before and after neuromuscular joint facilitation interventions via the cervical spine approach in healthy adults. [Participants and Methods] We included 16 healthy adults (9 males and 7 females). The interventions were performed successively, separated by a one-week interval. The order of interventions was randomized. The blood-flow velocity and diameter of the vertebral artery were measured before and after the intervention. The neuromuscular joint facilitation group underwent neuromuscular joint facilitation neck flexion pattern and extension pattern training on the right side of the cervical spine, while the control group was asked to rest for 5 min. [Results] The neuromuscular joint facilitation group showed a significant increase in systolic blood flow velocity and mean blood flow velocity of the right vertebral artery after the intervention. In contrast, the control group showed no significant differences for any of the measured parameters after the intervention. [Conclusion] Neuro-muscular joint facilitation intervention via the cervical spine approach may be recommended to improve vertebral artery function.

Key words: Blood flow velocity, Neuromuscular joint facilitation, Vertebral artery

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INTRODUCTION

Cervical spondylotic myelopathy, a degenerative disease, is the most common spinal cord disorder in adults¹). Cervical spondylosis includes neurogenic cervical spondylosis and vascular cervical spondylosis. The symptoms include transient dizziness due to rotational movement of the neck and impaired consciousness²). The main cause of cervical dizziness is impaired blood flow in the vertebral arteries due to cervical spine dysfunction. The osteophytes found in cervical spondylosis compress the vertebral arteries, resulting in cerebellar circulatory failure. The rotational movement of the cervical spine reduces blood flow in the vertebral arteries, thereby increasing the risk of dizziness.

Rehabilitation therapies include traction therapy, transcutaneous electrical nerve stimulation, soft tissue mobilization, and joint mobilization. However, there is insufficient evidence to support these treatments. Neuromuscular joint facilitation (NJF) is a new therapeutic exercise intervention based on kinesiology. It integrates the facilitation element of proprioceptive neuromuscular facilitation and joint composition movement, aiming to improve joint movement through passive, active, and

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resistance exercises³). Previous studies have reported that NJF intervention increases muscle strength⁴ and shortens muscle reaction time⁵ and that it is useful for improving motor dysfunction and pain relief in patients with periarthritis scapulo-humeralis, chronic low back pain, and knee osteoarthritis^{6, 7}). In addition, NJF intervention via the cervical spine approach has improved proprioceptive acuity⁸). In the clinical treatment, the NJF cervical spine approach is effective in improving cervical dizziness. Therefore, the purpose of this study was to examine the immediate effects of NJF intervention on blood flow velocity and diameter of the vertebral artery. The hypothesis is that the intervention of the NJF approach improves blood flow in the vertebral arteries.

PARTICIPANTS AND METHODS

The required number of samples was calculated using G*Power software, the effect size was set to 0.8 and power ($1-\beta=0.8$), the required number of samples was six. The participants were sixteen healthy adults (9 males and 7 females; age, 27.9 ± 5.8 years [mean \pm standard deviation]; height, 171.2 ± 10.2 cm; weight, 66.8 ± 12.4 kg). All participants provided informed consent to participate in the study. All experimental procedures in this study were reviewed and approved by the Ethical Review Committee of Jilin Dianli Hospital (JLDL2019-018). The study design is a clinical intervention study.

Blood pressure, heart rate, and the blood flow velocity and diameter of the vertebral artery were measured before and after the intervention. The parameters were measured after the subjects assumed the supine position. The blood flow velocity and diameter of the vertebral artery were measured using ultrasonography (Philips iU22 Ultrasound Machine in Doppler mode with L9-3 type 5–12 MHz linear transducer; Philips Medical Systems, Bothell, WA, USA). The site of measurement was between the C2 and C4 transverse processes on both the left and right sides. Blood flow velocity and blood vessel diameter were measured twice, and the average value was used as a representative value for analysis. Ultrasound measurements were performed by a clinical radiologist specializing in ultrasonography.

The NJF group underwent two NJF neck patterns—neck extension–lateral bending rotation and neck flexion–lateral bending rotation. The intervention site was at the C3–C7 spinous processes on the right side of the cervical spine. Each pattern was performed five times as resistance exercises. The resistance force of the exercises was measured using a hand-held dynamometer (HHD, μ Tas MT-1, Anima Company, Tokyo, Japan) by a physical therapist using the tester function of the HHD. The maximum force of distal resistance applied was controlled using the HHD. The maximum resistance of the neck extension–lateral bending rotation pattern was 9.2 ± 0.9 kg, and that of the neck flexion-lateral bending-rotation pattern was 5.6 ± 0.6 kg. NJF intervention was conducted by a senior NJF instructor.

In contrast, the intervention in the control group was 5 minutes of resting sitting position. The interventions were performed one after the other, separated by a 1-week interval. The order of interventions was randomized.

Two-way repeated-measures analysis of variance was used to test for statistically significant differences, and the factors were intervention and group. If any significant interaction was found, a paired t-test was used to compare the outcome indicators before and after intervention. Data were analyzed using SPSS Statistics for Windows version 17.0 (SPSS Inc., Chicago, IL, USA). A p-value of <0.05 was considered statistically significant.

RESULTS

In both groups, there was no change in blood pressure or heart rate before and after intervention (Table 1).

The systolic blood flow velocity ($p<0.01$) and average blood flow velocity ($p<0.05$) of the right vertebral artery increased after intervention in the NJF group, but there was no change in the control group (Table 2).

DISCUSSION

In NJF intervention via the cervical spine approach, the protraction of the head is performed by manual traction, and the sliding function of the intracapsular cervical facet joints is improved by proximal resistance to the spinous processes, resulting in a significant increase in the blood flow velocity of the vertebral arteries. In addition, a proximal resistance movement is thought to activate the deep muscles around the cervical spine, enhance the stability of the facet joints, and stabilize the

Table 1. Comparison of blood pressure and heart rate between the study groups

		NJF group		Control group	
		Before	After	Before	After
Blood pressure (mmHg)	Systolic	120.2 \pm 15.4	116.3 \pm 16.7	121.3 \pm 15.1	119.2 \pm 17.6
	Diastolic	81.7 \pm 9.9	80.6 \pm 12.2	82.5 \pm 10.0	81.3 \pm 11.8
Heart rate (beats/minute)		80.0 \pm 12.0	80.8 \pm 8.5	80.8 \pm 12.2	80.1 \pm 9.2

Values are presented as mean \pm standard deviation.

NJF: neuromuscular joint facilitation.

Table 2. Comparison of blood vessel diameter and blood flow velocity between the study groups

		NJF group		Control group		
		Before	After	Before	After	
Vertebral artery diameter (mm)	Left	3.6 ± 0.3	3.5 ± 0.3	3.5 ± 0.3	3.5 ± 0.3	
	Right	2.9 ± 0.4	3.0 ± 0.4	3.0 ± 0.4	2.9 ± 0.4	
Blood velocity (cm/s)	Left	Systolic	71.7 ± 13.6	70.9 ± 18.0	71.5 ± 13.0	71.6 ± 13.2
		Diastolic	25.2 ± 6.1	24.4 ± 6.6	25.9 ± 6.7	24.8 ± 6.4
		Average	40.4 ± 7.6	39.9 ± 9.3	41.0 ± 7.3	40.1 ± 8.6
	Right	Systolic	61.0 ± 15.1	66.3 ± 15.1**	61.6 ± 15.5	60.4 ± 14.8
		Diastolic	20.8 ± 5.9	21.4 ± 6.1	20.8 ± 6.2	20.5 ± 5.7
		average	34.1 ± 8.2	36.3 ± 8.3*	34.3 ± 8.3	33.8 ± 8.1

Values are presented as mean ± standard deviation.

Comparison with before intervention: *p<0.05; **p<0.01.

NJF: neuromuscular joint facilitation.

blood flow in the vertebral arteries. Our previous study has suggested that NJF intervention via the cervical spine approach improves cervical position sense error and is useful for improving cervical proprioceptor function.

NJF intervention via the cervical spine approach may be recommended to improve vertebral artery function. In clinical practice, NJF intervention via the cervical spine approach is used to improve the function of muscles (especially deep muscles that maintain the stability of the medullary joints) and facet joints, thereby relieving symptoms such as dizziness. Therefore, NJF may be a new therapeutic intervention for cervical dizziness.

The limitation of this study is that the participants were healthy adults. Hence, it is necessary to examine the clinical significance of the findings through clinical studies in the future. In our future research, we would like to examine the therapeutic effect of patients with cervical dizziness using the NJF cervical spine approach. In addition, although the immediate effects of NJF intervention were examined in this study, its long-term effects should be examined in future studies.

Conflict of interest

The authors declare no conflict of interest.

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