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Short-term Effectiveness of the Movement Direction in Neurodynamic Mobilization for Upper Limb Mobility and Pain

Background: Neurodynamic mobilization is divided into slider mobilization and tensioner mobilization. However, movement direction in neurodynamic mobilization has been overlooked in neurodynamic exercise program.
Objective: To examine the effect of movement direction in neurodynamic mobilization on upper limb mobility and pain.
Design: Quasi-experimental study
Methods: Twenty-two adults positive for neurodynamic test for the median nerve were recruited for participation in this study. Twenty-two subjects were allocated to the applied neurodynamic mobilization at limited side group (ANTLS, n=7), the applied neurodynamic mobilization at contralateral limited side group (ANTCLS, n=7), and the applied neurodynamic mobilization at bilateral side group (ANTBS, n=8). Before the intervention upper limb limited was measured neurodynamic test for the median nerve, pain was measured using visual analogue scale (VAS), movement direction in neurodynamic mobilization was applied to each group, and then re-measured using neurodynamic test for the median nerve and VAS. Differences the Intra-groups before and between the intergroups after intervention were analyzed.
Results: In the ANTLS and ANTBS groups, a statistically significant increase in ROM and decrease in VAS score in the population before and after intervention were indicated. Statistically significant differences in VAS and ROM from before to after intervention were found among the ANTLS, ANTCLS, and ANTBS groups.
Conclusions: The results of the present study indicate that movement direction in neurodynamic mobilization must be considered within the limits of its selected range of the neurodynamic exercise program.

Key words: *Neurodynamic mobilization, Neurodynamic test, Visual analogue scale, Rang of motion*

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INTRODUCTION

Neurodynamic mobilization is known as the mobility of the nervous system, which means that the nerve adapts to the mechanical system and normal movements of the nerve, such as stretching, tilting, slipping, cross-sectional changes, and compression.[1] The application of neurodynamic mobilization to paralyzed upper limbs of patients with neurological disorders has been shown to increase the range of motion (ROM) of the upper limbs, improve the flexibility of the neuromuscular muscles, and improve muscle strength.[2] In addition, owing to its stimulation of mechanical sensations, it immediately reduces cervical pain and is more effective than manual therapy for relieving shoulder or thoracic spine pain .[3]

Median nerve injury causes a lot of difficulties in daily activities of humans who use their hands frequently and increases the risk of injury due to desensitization. In these respect, damage to the nervous system due to various causes could lead to inherent problems with neural conduction, which in turn cause pain or dyskinesia.[4] In response to this problem, clinical physiotherapy laboratories develop interventions using neurodynamic mobilization to maintain neuronal function or treat neuronal dysfunction. The important factors in median neurodynamic mobilization are the depression of the shoulder girdle and the extension and external rotation of the arm.[5,6]

Neurodynamic mobilization intervention is of two types, a slide technique and a tensioner technique. The slide technique is used to make the slip without changing the length of the nerve, whereas the tensioner technique is used to lengthen the nerve by applying tension along the axis of the entire nerve.[5]

When static thigh muscle stretching was compared with static stretching applying both the neural slider and tensioner techniques in healthy people, the knee joint angle increased significantly in the neurodynamic mobilization group.[7] Systematic reviews stressed that neurodynamic mobilization is an effective way to improve flexibility, function, pressure pain thresholds, and disability, and to reduce pain.[8,9] Although many research studies have been conducted on neurodynamic mobilization, studies focusing on the movement direction of neurodynamic mobilization are insufficient. Therefore, the purpose of this study was to identify how the movement direction of neurodynamic mobilization affects mobility and pain.

SUBJECTS AND METHODS

Subjects

This study was conducted with 22 students from N University located in C City, Chungcheongnam-do, Korea, who had limited neuromotor mobility and agreed to participate spontaneously in this study. The subjects were divided into three groups. The allocation method was singular randomization using the tables of random numbers generated by a computer program as follows: applied neurodynamic mobilization for the limited-side group (ANTLS; n = 7), applied neurodynamic mobilization for the contralateral limited-side group (ANTCLS; n = 7), and applied neurodynamic mobilization for the bilateral-side group (ANTBS; n = 8). All the subjects were fully informed of the purpose, process, and method of the study before they participated in the study, and the process was approved by Namseoul University Institutional Review Board to protect the rights of the subjects (IRB 1041479-HR-201911).

The inclusion criteria of subjects were as follows[10]: first, those with an elbow extension angle of ≤150° in the neurodynamic test for the median nerve, and second, those who complained of neck or upper limb pain in the neurodynamic test for the median nerve. The exclusion criteria were as follows: first, patients with acute neck pain; second, patients with neck pain due to fractures; third, patients with neck surgery experience; fourth, patients with pain due to systematic diseases such as cancer; and fifth, people with sensory impairment or muscle weakness due to nervous system problems. The validity of the number of subjects was confirmed using G * Power 3.1. In this study, the sample size calculation was based on the change of neuro-mobility. In the analysis of variance (ANOVA), as the expected effect size of this study for the default value of the repeated measure was large, the entered values were as follows: effect size f=.40, α=.05, β=0.90, number of groups=3, and number of measurements=3.[11] The total number of samples was 22.

Neurodynamic test for the median nerve

A neurodynamic test for the median nerve was performed in the following order: first, fixing the shoulder girdle, second, opening the shoulder joint, third straightening the wrist/fingers, fourth forearm supination, fifth shoulder joint rotation, and sixth, straightening the elbow joint.[12] The starting position of the test was side-by-side lying with the body and legs straight without a pillow. The procedure of the neurodynamic test for the median nerve was described

Table 1. General features of the research subjects

	ANTLS (n = 7)	ANTCLS (n = 7)	ANTBS (n = 8)	p
Sex (male/female)	3/4	4/3	4/54	
Age (yr)	21.24 ± 2.47	21.26 ± 3.10	20.91 ± 2.75	.24
Height (cm)	168.72 ± 8.75	169.26 ± 7.70	168.72 ± 6.72	.51
Weight (kg)	69.04 ± 9.73	71.26 ± 10.03	71.45 ± 8.47	.49

ANTLS: Applied neurodynamic mobilization for the limited-side group, ANTCLS: Applied neurodynamic mobilization for the contralateral limited-side group, ANTBS: Applied neurodynamic mobilization for the bilateral-side group.

to the subjects, who were then instructed to express when they began to feel symptoms at certain points during the test and feel uncomfortable to continue their movements (pain threshold points). The elbow joint angle was measured at the pain threshold point. A goniometer was used for measuring the elbow joint angle (Goniometer, Dongbang Medical, Korea). The elbow joint angle was measured only once.

Visual analogue scale

The visual analogue scale (VAS) is a psychometric response scale that can be used in questionnaires for subjective characteristics or attitudes that cannot be directly measured. The scale is most commonly anchored by “no pain (0)” and “worst imaginable pain (10).” The starting point of “0,” indicates no pain, and the ending point of “10” indicates worst pain. The test-retest reliability and validity of the VAS were shown to be good in patients with chronic pain.[13]

Upper limb neurodynamic mobilization

Neurodynamic mobilization was taught and performed by a therapist who underwent musculoskeletal physiotherapy for 10 years in clinical field. Among the neurodynamic mobilization techniques, we applied the slider technique, which was found to be safer and to have a larger sliding range than the tensioner technique.[14] Neurodynamic mobilization involves the lateral bending of the neck and head to the ipsilateral side, with the elbow joint extension and the lateral bending of the neck and head to the opposite side when returning to the original position.[15,16] Neurodynamic mobilization was performed in 4 sets with a 30-second of resting phase between the sets. We also performed 12 neurodynamic mobilizations in the first set, 14 in the second set, 16 in the third set, and 18 in the fourth set. The gradual increase in the number of turns per set was aimed at minimizing the threshold value for the subject's adaptation and negative response to movement. Each time of the neurodynamic mobilization was performed to the point where the subject reported symptoms or the resistance was felt by the examiner. After holding for 1 second in the end range and returning to the original, the movement was performed for 2 seconds. In this way, four sets of ANTLS for the limited side group and four sets of ANTCLS were applied to the limited upper limb. ANTBS was applied in two sets on the bilateral sides.

Analysis

All statistical analyses were performed using SPSS version 20.0. The general characteristics of the participants were presented using descriptive statistics. Data normality was determined using the Shapiro-Wilk test. One-way ANOVA was used to identify the change between the groups. The post hoc test was the least significant difference. The paired T test was used to identify differences before and after among the groups. The significance level was set at $p<.05$.

RESULTS

In the ANTLS and ANTBS groups, a statistically significant increase in ROM and decrease in VAS score in the population before and after intervention were indicated (Table 3). Statistically significant differences in VAS and ROM from before to after intervention were found among the ANTLS, ANTCLS, and ANTBS groups (Table 3).

Table 2. Neurodynamic mobilization protocols

<table>
<tr><th>Group</th><th>Neurodynamic mobilization</th><th>Applied side/set/time</th></tr>
<tr><td>ANTLS</td><td rowspan="3">The lateral bending of the neck and head to the ipsilateral side, with the elbow joint extension and lateral bending of the neck and head to the opposite side when returning to the original position.</td><td>Affected side/4/12,14,16,18</td></tr>
<tr><td>ANTCLS</td><td>Unaffected side/4/12,14,16,18</td></tr>
<tr><td>ANTBS</td><td>Affected side/2/12,14
Unaffected side/2/12,14</td></tr>
</table>

ANTLS: Applied neurodynamic mobilization for the limited-side group, ANTCLS: Applied neurodynamic mobilization for the contralateral limited-side group, ANTBS: Applied neurodynamic mobilization for the bilateral-side group.

Table 3. Comparison of effects pre-and post-intervention

Variable	Group	ANTLS	ANTCLS	ANTBS	p Value (LSD result)
ROM	Pretest (Mean ± SE)	145.17 ± 3.89	143.52 ± 5.09	144.36 ± 4.57	.89
	Posttest (Mean ± SE)	169.27 ± 7.24†	147.58 ± 9.27	167.09 ± 8.14†	.00* (ANTCLS < ANTLS, ANTBS)
VAS	Pretest (Mean ± SE)	4.13 ± 1.57	4.25 ± 2.19	4.87 ± 1.74	.87
	Posttest (Mean ± SE)	2.47 ± .29†	3.97 ± 1.59	2.27 ± 1.07†	.02* (ANTCLS < ANTLS, ANTBS)

*Significant difference between the groups ($p<.05$). †Significant difference between before and after intragroup ($p<.05$). ANTLS: Applied neurodynamic mobilization for the limited-side group, ANTCLS: Applied neurodynamic mobilization for the contralateral limited-side group, ANTBS: Applied neurodynamic mobilization for the bilateral-side group.

DISCUSSION

As nerves and muscles move together as the body moves, nerve mobility is essential to move the body without limitation or resistance. Neurodynamic mobilization for neuromuscular disease is considered t the one of important treatments used in clinical practice along with the treatment for the muscles and joints.[17] Therefore, this study aimed to examine how the direction of movement in neurodynamic mobilization affects mobility and pain.

In the ANTLS and ANTBS groups, we found statistically significant increases in ROM and decreases in VAS score in the population from before to after intervention. Statistically significant differences in VAS and ROM were found between the groups after intervention with ANTLS, ANTCLS, and ANTBS.

Neurodynamic mobilization of the upper arm may help promote muscle tension, suppress or restore spasms in peripheral neuropathy, and improve dysfunction of the upper limb after brain injury.[12] Rozmaryn et al. (1998) also consistently performed neurodynamic mobilization in patients with carpal tunnel syndrome to relieve edema, one of the causes of carpal tunnel syndrome, and to improve nerve elongation and circulation, thereby reducing carpal tunnel internal pressure. The necessity of surgery was reduced by approximately 30% by applying neuro-mobilization techniques with a conservative treatment.[18] Akalin et al. (2002) reported that in patients with carpal tunnel syndrome, pain relief and function improved as a result of home stretch exercise after sprint treatment.[19] Ekstrom and Holden (2002) reported that neurodynamic mobilization reduced the needs for carpal tunnel surgery by nearly 30% in the patients with pain outside the elbow.[20] Tal-Akabi and Rushton (2000) reported that neurodynamic mobilization reduced pain and restored range of joint motion in patients with carpal tunnel syndorme.[20]

As shown in the previous studies, significant differences in VAS score and ROM were found between before and after intervention with ANTLS and ANTBS with neurodynamic mobilization, which relieves pain by improving neuronal flexibility and blood flow. This increases the ROM of the joints, which helps the body move, and the flexibility of the peripheral nerves, which promotes the speed of nerve conduction and reduces intraneuronal compression through the improvement of the axonal transport system.[1,21,22] However, the ANTCLS applied to the contralateral side, which was not attempted in previous studies, did not show any changes in the group before and after intervention. The reason is that the nerves are connected to both sides of the spinal cord, but because of the movement on the unaffected side is indirect, it is necessary to apply it to subjects with more severe neurodynamic limitation than those in the present study. In addition, increasing of the number and duration of neurodynamic activity applied in this study may have a positive effect.

This study seems to have certain limitations in generalizing the results because the subjects did not have complete control over the social and physical activities that may affect the research results other than the interventions related to the study. Subsequent studies are needed to compare the degree of neurodynamic mobility restriction and intervention duration.

CONCLUSION

In this study, neurodynamic mobilization was applied in patients with limited neurodynamic mobility in both the limited and unrestricted directions, demonstrating increased upper limb mobility and pain reduction. Therefore, this study suggests that the 'movement direction' needs to be considered during applying nurodynamic mobilization.

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