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The Immediate Effect of Neuromuscular Joint Facilitation (NJF) Treatment on Knee Muscle Force

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Abstract. [Purpose] The aim of this study was to investigate the change in knee muscle force of younger persons after neuromuscular joint facilitation (NJF) treatment. [Subjects] The subjects were 39 healthy young people, who were divided into two groups: a NJF group and a control group. The NJF group consisted of 26 subjects (16 males, 10 females), and the control group consisted of 13 subjects (7 males, 6 females). [Methods] Participants in the NJF group received NJF treatment. We measured the maximal flexor force and the maximal extensor force during isokinetic movement of the knee joint before and after intervention in both groups. The angular velocities used were 60°/sec, 180°/sec and 300°/sec. [Results] The NJF group showed significant increases in the maximal flexor force and the maximal extensor force after the intervention. In the control group, there were no significant differences. [Conclusion] These results suggest that there is an immediate effect of NJF intervention on knee muscle force.
Key words: Neuromuscular joint facilitation, Tibia rotation function, Knee muscle force

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INTRODUCTION

Strength training of the knee is often executed as a therapeutic exercise. Osteoarthritis (OA), one of the most common joint diseases in adults[1,2)], is a slowly evolving and degenerative articular disease. In elderly people's knee joint diseases, OA is the most common diseases and 25–40% of middle-aged and elderly persons have this syndrome regardless of the presence of symptoms. The pathophysiologies of knee OA are degeneration and wear loss of the articular cartilage. The occurrence of primary OA without anamnestic history, such as traumas and infections, is 90%[3)]. The primary complaints of patients are pain, stiffness, instability, and loss of function.

Neuromuscular Joint Facilitation (NJF) is used to increase strength, flexibility, and ROM. NJF is a new therapeutic exercise based on kinesiology, that integrates the facilitation element of proprioceptive neuromusclar facilitation and the joint composition movement, aiming to improve the movement of the joint through passive exercise, active exercise, and resistance exercise[4)].

The aim of the study was to investigate the change in the knee muscle force of younger persons before and after neuromuscular joint facilitation (NJF) treatment.

SUBJECTS AND METHODS

The subjects were thirty nine healthy young people, who were divided into two groups: a NJF group and a control group. The NJF group consisted of 26 subjects (16 males, 10 females), and the control group consisted of 13 subjects (7 males, 6 females). Subject characteristics are detailed in Table 1. All subjects were screened before the start of the study by filling out a medical history questionnaire. The questionnaire addressed whether the subjects had a history of cardiopulmonary, musculoskeletal, somatosensory, or neurological disorders. If so, they were excluded from the study. All subjects gave their informed consent to participation in the study.

We measured the maximal flexor force and the maximal extensor force during isokinetic movement of the knee joint, and the angle of knee when the maximal force was generated. A Biodex System 3 isokinetic dynamometer (Biodex Medical System, USA) was used for all the measurements. Each participant performed a 3-minute warm-up on a cycle ergometer followed by stretching exercises for the lower limbs. Subjects sat in a seat with the backrest at a 90-degree angle. Straps were placed over their shoulders and across the waist to ensure the torso was stable. An adjustable lever arm was attached to the subject's leg by a padded cuff,

Table 1. Subject Characteristics[a]

	Age (y)	Height (cm)	Weight (kg)
NJF [a] (n= 26)	19.4 ± 0.6	167.3 ± 9.5	60.9 ± 12.6
Control [b] (n= 13)	19.2 ± 0.4	167.7 ± 6.5	60.2 ± 7.0

Note: values are mean ± standard deviation. No significant differences between groups at the 0.05 alpha level. [a]: NJF group: neuromuscular joint facilitation group. [b]: Control: control group.

Table 2. Before and after intervention comparison of the maximal force (kg)

	Angular velocity	Maximum extensor force		Maximum flexor force	
		before	after	before	after
NJF [a]	60°	41.6 ± 12.2	42.0 ± 11.1	20.3 ± 7.5	22.1 ± 6.9**
	180°	26.8 ± 9.0	28.9 ± 7.6**	16.7 ± 6.3	18.6 ± 6.3**
	300°	20.8 ± 6.4	22.6 ± 6.7**	16.4 ± 5.8	17.8 ± 5.6**
Control [b]	60°	41.9 ± 9.4	41.5 ± 7.1	20.0 ± 5.2	21.3 ± 5.9
	180°	26.9 ± 7.5	26.7 ± 5.7	17.3 ± 4.8	17.0 ± 5.2
	300°	19.9 ± 5.2	21.1 ± 5.3	16.8 ± 5.1	17.2 ± 6.2

Note: values are mean ± standard deviation. Significant difference after intervention:
** : $p < 0.01$. [a]: NJF: neuromuscular joint facilitation group. [b]: Control: control group.

Table 3. Before and after intervention comparison of the angle of knee at which the maximal force was generated (°)

	Angular velocities	Maximum extensor force		Maximum flexor force	
		before	after	before	after
NJF [a]	60°	66.0 ± 6.1	69.3 ± 7.6	48.6 ± 16.1	45.3 ± 14.0
	180°	64.5 ± 7.4	66.2 ± 8.0	50.5 ± 27.6	43.1 ± 28.5
	300°	57.3 ± 14.5	61.8 ± 12.7*	67.8 ± 17.4	63.6 ± 23.7
Control [b]	60°	65.1 ± 11.4	70.3 ± 6.6	45.0 ± 12.7	36.4 ± 12.3
	180°	60.9 ± 8.2	65.9 ± 7.5	52.5 ± 27.4	45.9 ± 28.5
	300°	52.7 ± 18.3	54.3 ± 20.8	74.0 ± 16.4	66.2 ± 21.2

Note: values are mean ± standard deviation. Significant difference after intervention:
* : $p < 0.05$. [a]: NJF: neuromuscular joint facilitation group. [b]: Control: control group.

just proximal to the lateral malleolus. The axis of rotation of the dynamometer arm was positioned just lateral to the femoral epicondyle, and conventional concentric isokinetic tests were performed on the right lower extremity. During the test, the subjects continuously pushed the lever arm of the isokinetic device up and down, through the whole range of motion, between 10° and 90°(0°= straight leg). Each test consisted of a continuous maximal flexion- extension, and was repeated three times. The first was performed at 60°/sec, the second one was performed at 180°/sec, the third was performed at 300°/sec. A 3-minute rest was given between tests at each angular speed. To judge the immediate effect, the measurements were performed before and after the intervention.

Four knee patterns of NJF were used. The patterns were the knee extension-tibia external rotation (E-ER) pattern, the knee flexion-tibia internal rotation (F-IR) pattern, the knee extension- tibia internal rotation (E-IR) pattern, and the knee flexion- tibia external rotation (F-ER) pattern. Each pattern was performed three times at random as a passive exercise and as a resistance exercise. In the NJF group intervention, both proximal resistance and distal resistance were performed. In the control group intervention, only distal resistance was performed. The intervention was performed by the same physical therapist to avoid individual variations in treatment.

To determine whether there were differences between the NJF group and the control group, the independent t-test was performed on subject characteristics and each measure before the intervention. Two-way ANOVA and multiple comparisons (Bonferroni test) were used to test for statistically significant differences, and the factors were intervention and angular velocity for both groups. If a significant interaction was found, one-way analysis of variance was performed for each factor. To compare the angular velocities, the Bonferroni test was performed. To compare before and after the intervention, the paired t-test was performed. Data were analyzed using SPSS Ver. 12.0 for Windows. The level of statistical significant was chosen as 0.05.

RESULTS

There were no significant differences between the NJF group and the control group subject characteristics or each measure before the intervention.

Table 2 shows the results for the maximal force. The maximal flexor force and the maximal extensor force at the different angular velocities, in descending order, were 60°/sec, 180°/sec, and 300°/sec in both the NJF group and the control group, with the exception of miximal flexor force at 180°/sec, and 300°/sec in both groups.

In the NJF group, the maximal extensor force at 180°/sec, the maximal extensor force at 300°/sec, the maximal flexor force at 60°/sec, the maximal flexor force at 180°/sec, and the maximal flexor force at 300°/sec were significantly increased after the NJF treatment (Table 2).

There was a significant difference in the angle of knee at which the maximal extensor force at 300°/sec after NJF

treatment (Table 3).

In the control group, there were no significant differences at any angular velocity after the intervention (Table 2 and Table 3).

DISCUSSION

Excluding the maximal extensor force at 60°/sec, the maximal extensor force and the maximal flexor extensor force were significantly increased after the NJF treatment. Furthermore, the maximal extensor force at 300°/sec appeared earlier after NJF treatment, suggesting that the muscular activity of the white fibers of the quadriceps was improved after NJF treatment. The alignment in the knee joint capsule, the functions of the periarticular muscle of knee joint, and the tibia rotation function were improved; therefore, the maximal forces were increased after NJF treatment. Our study provides new evidence that NJF treatment is a more effective exercise than conventional therapeutic exercise at increasing knee strength. It may serve as a new form of exercise to improve the function of knee.

Future studies are needed to investigate the change in knee strengh after a long period of NJF treatment.

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