

The Immediate Effect of Neuromuscular Joint Facilitation (NJF) Treatment on Electromechanical Reaction Times of Hip Flexion

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Abstract. [Purpose] The aim of this study was to investigate the change in electromechanical reaction times (EMG-RT) of hip flexion 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 proprioceptive neuromuscular facilitation (PNF) group. The NJF group consisted of 16 subjects (7 males, 9 females), and the PNF group consisted of 23 subjects (10 males, 13 females). [Methods] Participants in the NJF group received NJF treatment. We measured the EMG-RT, the premotor time (PMT) and the motor time (MT) during hip flexion movement before and after the intervention in both groups. [Results] There were no significant differences among the results of the PNF group. For the NJF group, there were significant differences in PMT and EMG-RT after NJF treatment. [Conclusion] These results suggest that there is an immediate effect of NJF intervention on electromechanical reaction times of hip flexion.

Key words: Neuromuscular joint facilitation, Hip flexion, Premotor time

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INTRODUCTION

Walking is a widely accepted exercise¹⁾ and is used as a means of developing fitness in population based fall prevention programs²⁾. Stepping exercise appears to be effective at reducing the fall risk factors of older adults³⁾. The hip joint function affects both gait ability and stepping ability. Training of the hip is often executed as a therapeutic exercise. Proprioceptive neuromuscular facilitation (PNF) is a technique which is used to improve lower-limb muscle strength and gait function. Neuromuscular Joint Facilitation (NJF) is used to increase strength, flexibility, and ROM. NJF is a new therapeutic exercise based on kinesiology. It integrates the facilitation element of proprioceptive neuromuscular facilitation and the joint composition movement, aiming to improve the movement of the joint through passive exercise, active exercise, and resistance exercise⁴⁾.

To evaluate muscle function, strength, reaction time and spatial coordinates are quantified⁵⁾. The aim of the study was to investigate the change in the electromechanical reaction time (EMG-RT) of hip flexion of younger persons before and after neuromuscular joint facilitation treatment.

SUBJECTS AND METHODS

The subjects were thirty-nine healthy young people, who were divided into two groups: a NJF group and a PNF group. The NJF group consisted of 16 subjects (7 males, 9 females), and the PNF group consisted of 23 subjects (10 males, 13 females). Subject characteristics are detailed in Table 1. All subjects were screened before the start of the study using 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 this study. All experimental procedures in this study were reviewed and approved by the Ethical Review Committee of Jilin Dianli hospital.

We measured the EMG-RT of the rectus femoris (RF), the premotor time (PMT) of the RF, and the motor time (MT) of the RF in response to an auditory stimulus. The

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Table 1. Subject characteristics^a

	Age (y)	Height (cm)	Weight (kg)
NJF ^a (n=16)	20.3 ± 1.0	169.0 ± 9.2	59.4 ± 9.3
PNF ^b (n=23)	19.8 ± 0.9	165.0 ± 8.4	60.4 ± 11.9

Values are mean ± SD. No significant differences between groups at the 0.05 alpha level.

^a: NJF group: neuromuscular joint facilitation group, ^b: PNF group: proprioceptive neuromuscular facilitation group.

EMG-RT was measured with a digital storage oscilloscope, DCS-7040 (Kenwood). After cleaning the skin with alcohol and abrasion paste, Ag/AgCl disposable electrodes (Vitrode F, Nihonn Kohden) were placed over the muscle bellies of the RF, at a 2-cm inter electrode distance. The signal was turned on and off by the contact of an electrode attached to the calcaneus with an aluminum board. At the onset of voluntary hip flexion, the electrode lost contact with the aluminum board, and the signal was turned off (Fig. 1).

The subjects sat on a backless, adjustable seat with the right leg fixed in a position of 90° of hip flexion and 90° of knee flexion. The subjects were given an oral warning of "Set", 2 to 3 seconds in advance of the stimulus auditory signal (2,500 Hz, 50 ms). The subjects were required to respond to the auditory cues by flexing the hip as quickly as possible.

The EMG waveform and the on-off signal of the foot switch were synchronized on the display of the oscilloscope. The latency time between the onset of voluntary EMG activity and the stimulus auditory signal (PMT), and the latency time between the onset of voluntary EMG activity and the off signal (MT) were measured by setting the image on the display to a standstill each time and moving the cursor. Prior to the experiment, the subjects were informed of what would be done in the experiment and trial exercises were performed several times until subjects were accustomed to it. We measured the EMG-RT, the PMT and the MT during hip flexion movement before and after the intervention in both groups. The reaction time was measured five times at each scheduled measurement.

Four hip patterns of NJF were used. The patterns were: hip extension-abduction-internal rotation, the hip flexion-adduction-external rotation, the hip flexion-adduction-external rotation, and the hip flexion-abduction-internal rotation. 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 PNF 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 PNF 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 group. If a significant interaction was found, the paired t-test was performed to compare before and after the

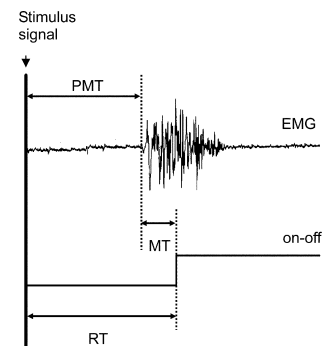


Fig. 1. Schema of the electromyographic reaction time
Upper trace: electromyographic waveform.
Lower trace: on-off signal of the foot switch.
The left vertical line shows the stimulus auditory signal.
PMT: premotor time.
MT: motor time. RT: electromechanical reaction time.

intervention. Data were analyzed using SPSS Ver. 17.0 for Windows. The level of statistical significance was chosen as 0.05.

RESULTS

There were no significant differences between the NJF group and the PNF group subject characteristics or each measure before the intervention (Table 1).

Two-way ANOVA showed there were significant interactions among the EMG-RT, the PMT and the MT of groups, indicating that the change was different between the groups. There were no significant differences among the results of the PNF group. The NJF group showed significant shortening of the EMG-RT and the PMT after the intervention (Table 2).

DISCUSSION

This study investigated the effects of a neuromuscular joint facilitation treatment on EMG-RT. The shortened PMT means that arousal levels and attentiveness were improved, and the reaction time became faster as a result of the NJF intervention. This was in agreement with the results of a previous study, which concluded that NJF shortens the EMG-RT of knee extension⁶.

The proprioceptive senses were heightened, since the alignment of the hip joint capsule and the functions of the periarticular muscle of hip joint were improved; therefore, the reaction time of hip flexion was shortened after NJF treatment. An important difference between the interven-

Table 2. Comparison before and after intervention of each measurement item (msec)

		before	After
NJF ^a	PMT ^c	290.5 ± 31.5	268.8 ± 23.8**
	MT ^d	47.9 ± 19.0	56.0 ± 16.3
	RT ^e	338.6 ± 22.0	324.5 ± 22.8**
PNF ^b	PMT	283.7 ± 22.7	290.3 ± 33.0
	MT	56.7 ± 16.7	52.7 ± 17.7
	RT	340.3 ± 30.2	343.0 ± 40.5

Values are mean ± SD, Comparison with before intervention: *: p<0.05; **: p<0.01.

^a: NJF group: neuromuscular joint facilitation group, ^b: PNF group: proprioceptive neuromuscular facilitation group, ^c: PMT: premotor time, ^d: MT: motor time, ^e: RT: electromechanical reaction time; RT= PMT+MT.

tion methods was that, the rotation function of the caput femoris was emphasized in the NJF group. In the NJF resistance exercise, the caput femoris rotation was drawn out using proximal resistance on the greater trochanter of the femur. The results suggest that caput femoris rotation function can be improved by NJF treatment, and that improve-

ment of caput femoris rotation contributes to shortening the reaction time. Our study provides new evidence that NJF treatment is a more effective exercise than PNF treatment at shortening hip reaction time. It may serve as a new form of exercise for the improvement of the function of hip.

Further studies are needed to investigate the change in the EMG-RT of hip after a long period of NJF.

REFERENCES

- 1) Simonsick EM, Guralnik JM, Fried LP: Who walk? Factors associated with walking behavior in disabled old women with and without self-reported walking difficulty. *J Am Geriatr Soc*, 1999, 47: 672–680. [[Medline](#)]
- 2) McClure R, Turner C, Peel N, et al.: Population-based interventions for the prevention of fall-related injuries in older people. *Cochrane Database Syst Rev*, 2005, 1: CD004441. [[Medline](#)]
- 3) Shigematsu R, Okura T, Nakagaichi M, et al.: Square-stepping exercise and fall risk factors in older adults: a single-blind, randomized controlled trial. *J Gerontol A Biol Sci Med Sci*, 2008, 63: 76–82. [[Medline](#)] [[Cross-Ref](#)]
- 4) Huo M: *Neuromuscular Joint Facilitation*. Tokyo: Ipec Press, 2010, pp 3, 127–138 (in Japanese).
- 5) Inohara H, Katou H, Kitou N: *Conservative Therapy of Osteoarthritis seen from Multijoint Kinetic Chain*. Tokyo: Zennihonbyouin Press, 2008, p 35 (in Japanese).
- 6) Huo M, Ge M, Li D, et al.: Effects of neuromuscular joint facilitation on electromechanical reaction time of rectus femoris. *J Phys Ther Sci*, 2012, 24: 55–57. [[CrossRef](#)]