

Effects of Neuromuscular Joint Facilitation on Electromechanical Reaction Times of the Teres Major

MING HUO, PT, PhD¹⁾, DESHENG LI, PT, MS²⁾, MENG GE, PT³⁾,
QIUCHEN HUANG³⁾, HITOSHI MARUYAMA, PT, PhD¹⁾

¹⁾Department of Physical Therapy, Faculty of Health Science, International University of Health and Welfare: 2600-1 Kitakanemaru, Ohtawara City, Tochigi 324-8501 Japan.
TEL +81 287-24-3000, E-mail: huoming8@gmail.com

²⁾China Rehabilitation Research Center

³⁾Research Institute of Health and Welfare Sciences, Graduate School, International University of Health and Welfare

Abstract. [Purpose] The aim of the study was to investigate the changes of electromechanical (EMG) reaction times (RT) of the human teres major after neuromuscular joint facilitation (NJF) treatment. [Subjects] The subjects were 17 healthy males who were divided into two groups: a NJF group and a control group. The NJF group consisted of 10 subjects, and the control group consisted of 7 subjects. [Methods] Participants in the NJF group received NJF treatment. The EMG-RT, the premotor time (PMT) and the motor time (MT) during shoulder internal rotation movement were measured before exercise, right after exercise, and at 10, 20 and 30 minutes after exercise. [Results] There were no significant differences among the results of the control group. For the NJF group, there were significant differences in EMG-RT and MT between pre- and post- exercise, and 10–20 minutes after exercise, and there were significant differences in PMT between pre- and post- intervention, and 10 minutes after the intervention. [Conclusion] NJF intervention shortens not only PMT but also MT, which implies that NJF is effective for both premotor and motor processes.

Key words: Neuromuscular joint facilitation, Premotor time, Motor time

(This article was submitted Sep. 5, 2011, and was accepted Sep. 12, 2011)

INTRODUCTION

Neuromuscular Joint Facilitation (NJF) is a new therapeutic exercise based on kinesiology, that 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 exercise¹⁾. It is used to increase strength, flexibility and ROM.

The electromechanical reaction time (EMG-RT) is an index of the shrinkage characteristic of the muscle. EMG-RT is composed of premotor time (PMT) and motor time (MT). The PMT is defined as the interval between the stimulation signal and the onset of voluntary electromyographic (EMG) activity of a response agonist. The MT is defined as the interval between the onsets of voluntary EMG activity to the mechanical response²⁾. The PMT reflects the movement position, the movement pattern, the movement programming, the state of consciousness, the level of alertness, and the time of the central process. The MT chiefly reflects factors at the periphery level, including muscle contraction, series elasticity, and difficulties in loosening of connective tissue and the joint capsule³⁾.

To evaluate muscle function, strength, reaction time and spatial coordinates are quantified⁴⁾. The aim of this study

was to investigate the change in the electromechanical reaction time (EMG-RT) of the human teres major after neuromuscular joint facilitation (NJF) treatment.

SUBJECTS AND METHODS

The subjects were seventeen healthy males, who were divided into two groups: a NJF group and a control group. The NJF group consisted of 10 subjects, and the control group consisted of 7 subjects. 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 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 EMG-RT of the teres major, the PMT of the teres major, and the MT of the teres major in response to an auditory stimulus. The 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 teres major with a 2-cm inter-electrode distance. The on-off signal was generated by the contact of an electrode attached to the dorsum manus with

an aluminum board. At the onset of voluntary shoulder internal rotation, the electrode lost contact with the aluminum board, generating the off signal (Fig.1).

The subjects sat on a backless adjustable seat with the right upper limb fixed in a position of 90° of shoulder flexion and 90° of elbow flexion. The subjects were given an oral warning of “Set” for 2 to 3 seconds before the stimulus auditory signal (2500 Hz, 50 ms). The subjects were required to respond to the auditory cues by performing shoulder internal rotation as quickly as possible.

There EMG waveform and the on-off signal of the foot switch were synchronized on the display of the oscilloscope. The latent time between the onset of voluntary EMG activity and the stimulus auditory signal (PMT), and the latent 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 about what would be done in the experiment and made several practice trials to accustom themselves to it. We measured the EMG-RT, the premotor time (PMT) and the motor time (MT) during shoulder internal rotation movement before exercise, right after exercise, and at 10, 20 and 30 minutes after exercise in both groups. The reaction time was measured repeatedly five times at each scheduled measurement.

Four shoulder patterns of NJF were used. The patterns were shoulder extension-adduction-internal rotation (Ext-Add-IR), shoulder flexion-abduction-external rotation (Flex-Abd-ER), shoulder extension-abduction-internal rotation (Ext-Abd-IR), and shoulder flexion-adduction-external rotation (Flex-Add-ER) pattern. Each pattern was performed three times at random as a passive exercise and as a resistance exercise, respectively. We measured the resistance force of the resistance exercise with two hand-held dynamometers (HHD, ANIMA MT-1) held in each hand of a physical therapist, and the maximal resistance force was measured using the tester function of HHD. Table 2 shows the resistance force and duration of the procedure for the shoulder joint. For the NJF group intervention, both proximal resistance and distal resistance were performed. For the control group, only distal resistance was performed. The intervention was performed by the same physical therapist to avoid individual variations in therapy.

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

RESULTS

There were no significant differences between the subject characteristics of the NJF group and the control

Table 1. Subject Characteristics

	NJF ^a (n=10)	Control ^b (n=7)	Sum total (n=17)
Age (y)	22.9 ± 2.6	22.7 ± 0.5	22.8 ± 2.0
Height (cm)	175.8 ± 7.6	173.1 ± 11.3	174.7 ± 9.1
Weight (kg)	71.6 ± 13.0	73.0 ± 19.2	72.2 ± 15.3

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.

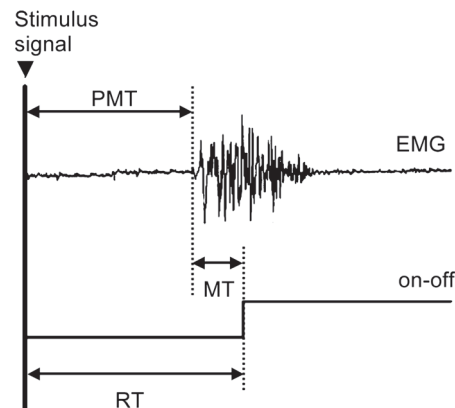


Fig. 1. Schema of electromyographic reaction time. Upper trace: electromyographic waveform. Lower trace: on-off signal of the foot switch. Vertical line shows the auditory stimulus signal. PMT: premotor time. MT: motor time. RT: reaction time. RT=PMT+MT

group.

Table 3 shows the results for reaction time. Two-way analyses of variance showed there was a significant interaction of group, indicating that the change in RT was different between the groups. There were no significant differences among the results of the control group. For the NJF group, there were significant differences in EMG-RT and MT between pre- and post-intervention, and 10 and 20 minutes after exercise, and there were significant differences in PMT between pre- and post-intervention, and 10 minutes after exercise.

DISCUSSION

The study investigated the effects of a Neuromuscular Joint Facilitation treatment on EMG-RT. The subjects of the NJF group showed not only shortened PMT, but also shortened MT in the teres major. We think that PMT was shortened by improvements in the levels of arousal and attentiveness, and a quicker reaction, all brought by the NJF intervention. In addition, MT was shortened immediately after the intervention, suggesting that the contractile characteristic of the muscle were changed by the NJF intervention. MT is influenced by the muscle tone before a movement appears⁵⁾, and the shortening of MT has been

Table 2. The resistance force and duration of NJF treatment for the shoulder joint (n=6)

Pattern	Proximal resistance force (kg)	Distal resistance force (kg)	Duration of procedure (sec)
Ext-Add-IR ^a	9.6 ± 0.8	12.9 ± 2.2	3.0 ± 0.4
Flex-Abd-ER ^b	9.4 ± 1.2	8.2 ± 1.2	4.7 ± 0.3
Ext-Abd-IR ^c	8.4 ± 0.6	8.4 ± 1.7	4.0 ± 0.9
Flex-Add-ER ^d	9.0 ± 0.7	14.1 ± 4.1	4.5 ± 0.5

^a: Ext-Add-IR: shoulder extension-adduction-internal rotation pattern. ^b: Flex-Abd-ER: shoulder flexion-abduction-external rotation pattern. ^c: Ext-Abd-IR: shoulder extension-abduction-internal rotation pattern. ^d: Flex-Add-ER: shoulder flexion-adduction-external rotation pattern.

Table 3. Comparison of before and after intervention values of each measurement item (msec)

		before	right after exercise	after 10 min	after 20 min	after 30 min
NJF ^a	PMT ^c	127.9 ± 20.4	112.0 ± 11.5*	111.5 ± 11.9*	110.3 ± 11.2	110.5 ± 16.3
	MT ^d	56.4 ± 9.6	48.2 ± 8.9**	44.7 ± 6.9**	45.5 ± 10.3*	47.5 ± 11.1
	RT ^e	184.3 ± 21.6	160.3 ± 13.9**	156.3 ± 14.1**	155.8 ± 16.1*	158.0 ± 21.5
Control ^b	PMT	123.7 ± 17.7	117.2 ± 5.6	121.8 ± 17.8	124.7 ± 30.1	124.9 ± 13.5
	MT	47.4 ± 7.9	48.3 ± 14.5	48.1 ± 13.6	53.2 ± 8.7	48.9 ± 9.8
	RT	171.1 ± 22.3	165.5 ± 9.4	169.8 ± 22.1	177.8 ± 25.0	173.8 ± 9.5

Note: values are mean ± standard deviation. Comparison before and after intervention: *: p<0.05; **: p<0.01. PMT: premotor time; MT: motor time; RT: reaction time.

suggested to be the result of an increase in muscular tension induced by changes in the mechanical properties of the muscle tissue⁶⁾.

There were no significant differences among the results of the control group. As in a previous study, resistance training did not change RT (premotor time, motor time, or reaction time)⁷⁾.

NJF intervention shortened not only PMT but also MT, which implies that NJF is effective for both premotor and motor processes.

REFERENCES

- 1) Huo M: Neuromuscular Joint Facilitation. Tokyo: Ipec press, 2010, p 3 (in Japanese).
- 2) Nakamura R: Clinical Kinesiology. Tokyo: Ishiyaku press, 2002, p 270 (in Japanese).
- 3) Nakamura R: Examination of movement appearance by electromyogram response time. Rinsyounouha, 1988, 30: 566–572(in Japanese).
- 4) Inohara H, Katou H, Kitou N: Conservative Therapy of Osteoarthritis seen from Multijoint Kinetic Chain. Tokyo: Zennihonbyouin press, 2008, p 35(in Japanese).
- 5) Ward T: Muscle state: Reaction and Movement time in elbow extension. Arch Phys Med Rehab, 1978, 59: 377–383.
- 6) Schmidt RA, Stull GA: Premotor and motor reaction time as a function of preliminary muscular tension. J Motor Behav, 1970, 2: 96–110.
- 7) Anonymous: Sport medicine; new sports medicine findings from D. P. Laroche and co-authors described. Medical Sciences, 2008, 2054.