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Letter to the Editor

Effects of Plyometric Training on Electromechanical Delay of College Women

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Dear Editor-in-Chief

Electromechanical delay (EMD) refers to the time elapsed from the onset of electrical muscle activation to the onset of force production, which reflects the electrochemical process and the mechanical process (1, 2). In the isometric contraction study, the biceps brachii of the upper limbs (3) and the quadriceps femoris of the lower limbs (4) are mainly used as the patch site for electromyography (EMG), and efforts to indirectly examine the muscular elasticity components via the EMG and the manifested strength are made. Therefore, attempts to use EMD as a muscular elasticity index were made in this study, by conducting plyometric training to improve muscular elasticity for twelve weeks in female college students that do not participate in regular exercise.

This study enrolled twelve healthy, female college students. The subjects were of mean age 21.3 yr old, of mean height 163.0 cm and mean weight, 53.2 kg.

This study was approved by the Ethics Committee of the Hankuk University of Foreign Studies, in 2017.

The results of analysis on the force and EMD upon flexion and extension at the vastus lateralis of the right leg after twelve weeks of plyometric training showed a significant difference in the level of force and EMD after the training compared with before the training (Table 1).

Table 1: The results of force and EMD during maximal isometric contraction in right leg

Variable	*Flexion*		*Extension*	
	Pre-training	Post-training	Pre-training	Post-training
Force (kg)	28.6±5.3	33.8±6.3**	34.8±5.6	40.1±5.3***
EMD (msec)	76.3±7.6	64.1±5.1***	65.1±5.0	52.4±6.5***

The results of analysis on the force and EMD upon flexion and extension at the vastus lateralis of the left leg after twelve weeks of plyometric training showed significant differences in the level of force and EMD after the training compared with before the training upon flexion. In

contrast, the level of EMD significantly declined ($P<.001$) with no significant difference in the level of force upon extension (Table 2).

Table 2: The results of force and EMD during maximal isometric contraction in left leg

Variable	*Flexion*		*Extension*	
	Pre-training	Post-training	Pre-training	Post-training
Force (kg)	26.2±3.9	31.3±5.4***	30.0±3.1	32.4±6.4
EMD (msec)	78.0±6.6	67.4±5.2***	71.0±4.1	60.9±3.5***

As a result of the study on the reaction time to jumping exercise in male and female college students, it was found that not only muscular reflex and elasticity but also nerve conduction from the brain are crucial. It also suggests that the decline of the force and EMG upon squeezing with the maximal isometric contraction according to the presence and absence of stretching, which leads to proprioceptive neuro- muscular facilitation (PNF), is influenced by nerve conduction from the brain. Furthermore, the result of this study correlates well with those revealed by a previous study which reported that the level of EMD at the vastus lateralis after twelve weeks of plyometric training could be determined depending on the structural differences of the nervous system (5). The EMD has shortened due to the development of a rapid muscle ratio and the EMD of the triceps brachii with greater rapid muscle ratio upon muscular contraction was shorter than that of the biceps brachii (6). After 24 weeks of training, with a rapid contraction rate on the brachial biceps and femur vastus lateralis as the protagonists, the EMD level was reported to be significantly decreased after the training compared with the level before the training, suggesting that the decline of EMD is caused by the improvement of elastic components after training (7, 8).

To conclude, plyometric training helps to increase muscular elasticity, positively influencing the EMD with the enhancement of muscular force and increasing EMG activity upon maximal isometric con- traction. Therefore, plyometric training plays an important role in increasing the elastic components of the vastus lateralis, and thus could serve to decrease the level of EMD. This seems to offer a more efficient mechanism for strength exertion based on not only muscular development caused by the training but also an increase in nerve conduction from the brain.

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Conflict of interest

The authors declare that there is no conflict of interest.

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