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THE EFFECT OF MACH DRILLS TRAINING ON THE START MOVEMENT OF IN-LINE SPEED SKATING

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The purpose of this study was to analyze the relative muscle activation of the start movement and the Mach Drills training program. 5 in-line skating players participated in the study and 9 Wireless EMG sensors were placed over the rectus femoris, biceps femoris, semitendinosus, tibialis anterior, gastrocnemius, peroneus longus, adductor magnus, tensor fascia lata, and gluteus maximus. Results showed that significantly lower gastrocnemius IEMG value in skating. However, it also showed that RF, TA, and PL had higher IEMG value in skating and significant difference was found for TA. Another muscle activation didn't have significantly difference. It suggested that athletes had to increase more specific training program for rectus femoris muscle and peroneus longus muscle which play an important roles for start movement in skating.

KEY WORDS: In-line speed skating, Mach Drills training, survey, Electromyography

INTRODUCTION: Recently, In-line speed skating has become one of the fastest-growing sports. A short distance race ranged from 100 m to 300 m is a competition that skaters race individually or in pairs and attempts to establish the best time. According to past study, an excellent start movement could provide more efficiency energy transfer to produce more muscle power and obtain higher acceleration (Publow, 1999). The Mach Drills training was designed by Gerard Mach as exercises to develop specific strength in the muscles used in sprinting (Pawar & Baliram, 2011). Mach broke the stride into its components parts, knee lift (A), foreleg action (B) and the push off (C) through the drills. The Mach Drills training included March A, B; Skip A, B; Sprint A, B; and Bounding A, B. According past study, after eight weeks Mach Drills training, athletes' power of lower limb and the speed of sprint were progressing significantly (Lin et al., 2012). Therefore, the aim of this study was to analyze the relative muscle activation of the start movement and the specific training program.

METHODS: 5 elite in-line skating players (age range was 20 to 27 years old) from the national team participated in the study. The TrignoTM Wireless EMG System (Delsys, Inc., USA) were placed over the rectus femoris, biceps femoris, semitendinosus, tibialis anterior, gastrocnemius, peroneus longus, adductor magnus, tensor fascia lata, and gluteus maximus of right leg. The EMG sensors are fixed lengthwise over the muscle belly and secured with surgical tape and cloth wrap, and electrode wires are also secured to an elastic belt worn by subjects to minimize disruption during movement. Before starting test, subjects had to measure the maximum voluntary contractions (MVC) for each muscle. Subjects were asked to perform start movement for 3 times and then performed the Sprint A, B of Mach Drills for 3 times after 5 minutes rest. We only recorded the EMG data during sprint of Mach Drills, because this movement was more similar to the start movement of skating. The EMG linear envelope was calculated from the raw EMG signal through fourth-order Butterworth 40-400 Hz band-pass filtering, rectifying, and normalization procedures where timing is represented by percent of step cycle (% step cycle). For each individual, amplitude was normalized to MVC and graphed as percent of maximum muscle amplitude (%). The normalized signal was integrated to produce an integrated EMG (IEMG) value and the ratio was calculated from the IEMG in skating and in Mach drills training. Finally the relative muscle activation on Mach Drills training and the start movement of In-line speed skating were compared. SPSS statistical software (SPSS Inc., USA) was used in this study for statistical analysis. The Paired t-test is used to determine the IEMG between In-line speed skating and Mach Drills training. A statistical significance level was set at $p< 0.05$.

RESULTS: The mean value and ratio of IEMG was showed in the **Table 1**. The result showed that significantly lower gastrocnemius IEMG value were found in skating than in Mach Drills training (3944.97 vs. 6223.88). Furthermore, the results also showed that Rectus Femoris, Tibialis Anterior, and Peroneus Longus had higher IEMG value in skating than in Mach drills training. Although the significantly difference was only found for Tibialis Anterior (6466.50 vs. 4161.35).

Table 1
The mean value of IEMG for start movement of skating and Mach Drills

Muscle	Skating	Mach Drills	Ratio
Rectus Femoris	8422.66	6333.94	0.75
Biceps Femoris	3996.44	4526.48	1.13
Semitendinosus	5187.87	5230.90	1.01
Tibialis Anterior	6466.50	4161.35	0.64*
Gastrocnemius	3944.97	6223.88	1.58*
Peroneus Longus	7127.41	4292.16	0.60
Adductor Magnus	6545.26	7579.14	1.16
Tensor Fascia Lata	4686.47	4672.76	1.00
Gluteus Maximus	6542.35	5394.18	0.82

* p value < 0.05

DISCUSSION:

To perform an excellent start movement, the lower limbs muscles have to produce more muscle power at shortest time to spend and produce the maximum velocity. In the present study, the Mach Drills training could perform similar muscle performance in the biceps femoris, semitendinosus, adductor magnus, and tensor fascia lata. This result may reflect that the specific training program could provide enough training strength for those muscles. However, the IEMG value for tibialis anterior muscle in Mach Drills training showed significantly lower than skating. In the skating condition, subjects had to maintain the foot at the dorsiflexion position to keep the wheels could full contact the ground. But, it was not a necessary motion that kept the foot dorsiflexion in Mach Drills training. That may cause the lower tibialis anterior muscle activation in Mach Drills training.

Futhermore, the agonist for push off such as rectus femoris and gastrocnemius showed difference results in skating and Mach Drills training. According to **Table 1**, the rectus femoris muscle showed higher IEMG value, but lower IEMG value was also be found for gastrocnemius in skating. These results may reflect that using Mach Drills training could useful train the gastrocnemius muscle but it was not enough for rectus femoris muscle.

Although it did not have significant different, the IEMG value showed lowest ratio for peroneus longus muscle. This result may be affected by the specific movement for skating. During start phase, in-line skating players used to keep the foot at the pronation pisition but it did not be found in Mach Sprint Drills. Therefore, it would result in the lower EMG activation for peroneus longus in Mach Drills training.

CONCLUSION:

To sum up, using the Mach Drills training could achieve the similar muscle activation in skating for biceps femoris, semitendinosus, adductor magnus, and tensor fascia lata. However, it had to increase more specific training program for rectus femoris muscle and peroneus longus muscle which play an important roles for start movement in skating.

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