EFFECT OF TRAINING FOR NEUROMUSCULAR CONTROL ON PERFORMANCE OF CHOICE REACTION SIDESTEP CUT

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The purpose of this study was to identify the effect of neuromuscular control training on a performance of the sidestep cut with a choice reaction task. Three stages were set in this study. The first one was an experimental session before training (PRE). This was followed by an 8-week training period, and finally an experimental session (POST) after the completion of training. Mean foot contact time in the POST was significantly shorter than in the PRE. The average rectified value (ARV) ratio of electromyography (mean ARV value for 100 ms before foot contact divided by mean ARV value for 100 ms after foot contact) of the rectus femoris was significantly greater in the POST than in the PRE. These results suggest that the postural adjustments for sidestep cut were performed in a shorter time with the aid of neuromuscular control training.

KEY WORDS: central nerve system, pre-activity, electromyography, kinetics.

INTRODUCTION: In many ball game sports such as basketball and soccer, Players are often forced to change their running direction in a moment to react to several game situations. These reaction movements were difficult to make postural adjustments because of the short time provided (Besier et al., 2001). On the other hand it was suggested that muscle activity before ground contact (pre-activity) could enhance the following drop jump performance (Horita et al., 2002). The preprogrammed nature of the postural adjustments suggested that there may be insufficient time for the Central Nerve System (CNS) to plan appropriate activation strategies (Besier et al., 2003). The purpose of this study was to identify the effect of neuromuscular control training on a performance of the sidestep cut with a choice reaction.

METHODS: Three stages were set in this study. The first one was an experimental session before training (PRE). This was followed by an 8-week training period, and finally an experimental session (POST) after the completion of training. Nine university male basketball players (age: 20.2 ±1.5 years, height: 1.81 ±0.04 m, body mass: PRE; 79.8 ±4.7 kg, POST; 78.6 ±5.7 kg, average ±SD) were asked to perform repeated trials of the choice reaction tasks at the experimental session. Subjects were instructed to take one of three directions after the right foot landed on a force plate (FP; 1kHz, 0.90 × 0.60 m, Kistler, Switzerland) following the light signals during the approach. These directions were 60 degrees to the left (sidestep cut), 60 degrees to the right (crossover cut), and straight run. The instructions of three directions and three timings, namely at 3.0 - 3.3m before the FP centre (180 % Body height), at 2.0 - 2.2 m before the FP centre (120 % Body height), and at 1.0 - 1.1 m before FP centre (60 % Body height), were given randomly by a LED signal in front (Figure 1). In this study we only analyzed the sidestep cut under the choice reaction sidestep cut tasks which instructed at 2.0 - 2.2 m before the FP centre. Twenty-two reflective markers were affixed to lower limb landmarks to record three-dimensional lower limb movements using 13 cameras, 250 Hz VICON motion analysis system (Oxford Metrics, Oxford, UK). Ground reaction forces (GRF) were recorded using three FPs. The average rectified values (ARV) of the wireless electromyography (EMG; 1kHz, S&ME, Japan) of the right lower extremity muscles (Rectus femoris; RF, Gluteus medius; GM, Semitendinosus; ST, Vastus medialis; VM, medial gastrocnemius; MG) during 100 ms before the right foot (cutting leg) contact and 100 ms after contact were recorded. Kinematics and kinetics of sidestep cutting manoeuvres and the ARV of EMG, were compared using paired *t* tests procedures (α=0.05) between PRE and POST. During the training period, which was continued for 8 weeks three or four times per week, the instructions of two directions and stop task were shown randomly by a LED signal 0.9 s after the start signal in front (Figure 2). Subjects were instructed to start from a start gate to gate 1 then take one of three actions, namely to go to gate 2L, or gate 2R, or stop, according to the LED signal. We instructed them to go at jogging pace because this training program aimed that subjects adapt themselves to the choice reaction at a slow running pace. This training program was continued 24 trials per person in a day.

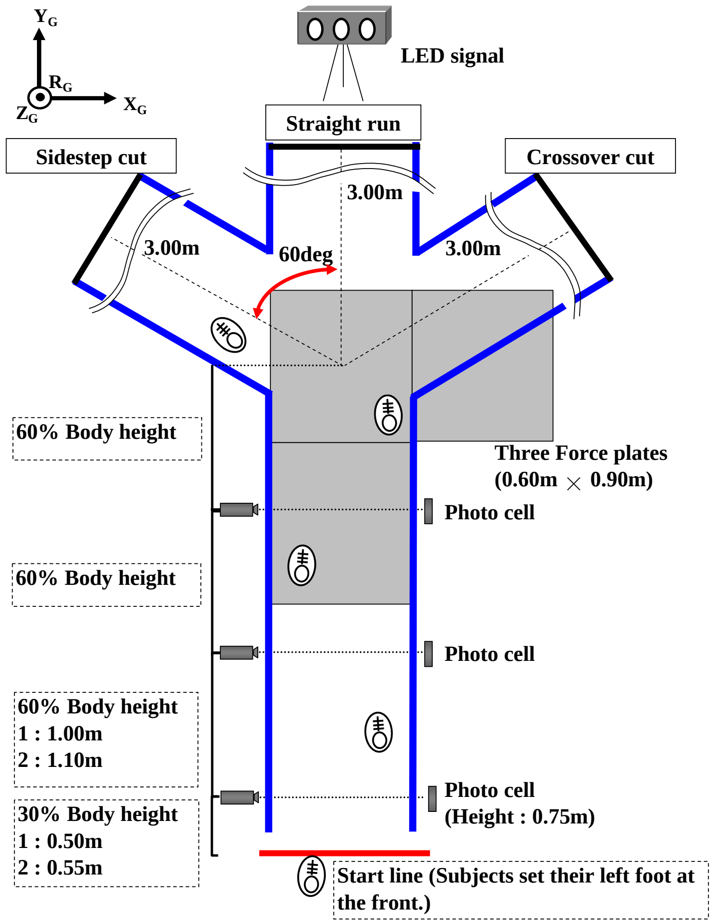

Figure 1: Experimental set up.

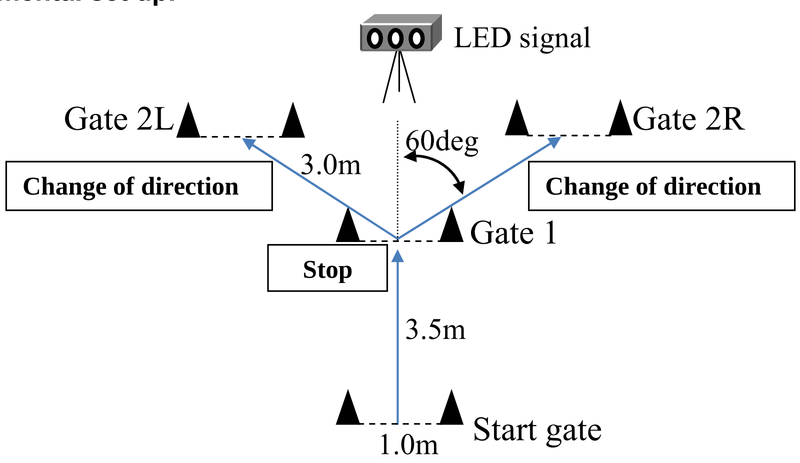

Figure 2: Schematic diagram of training set up.

RESULTS: Mean running speed at touchdown and toe off was 3.72 ±0.52 m/s, 3.82 ±0.26 m/s in the PRE, and was 3.86 ±0.47 m/s in the POST, 3.87 ±0.22 m/s respectively. There were no significant differences between two conditions ($\alpha>0.05$). Mean foot contact time in the POST was significantly shorter than in the PRE (PRE: 300 ±32 ms, POST: 269 ±30 ms) ($\alpha<0.05$). Mean peak ankle plantar-flexion torque for 100 ms after foot contact in the POST was tended to be larger than in the PRE (Figure 3). Figure 4 shows the results of the ARV ratio (Mean values for 100 ms before foot contact divided by mean values for 100 ms after foot contact). The ARV ratio of the RF was significantly greater in the POST than in the PRE (PRE: 38.0 ±15.3 %, POST: 86.7 ±57.4 %).

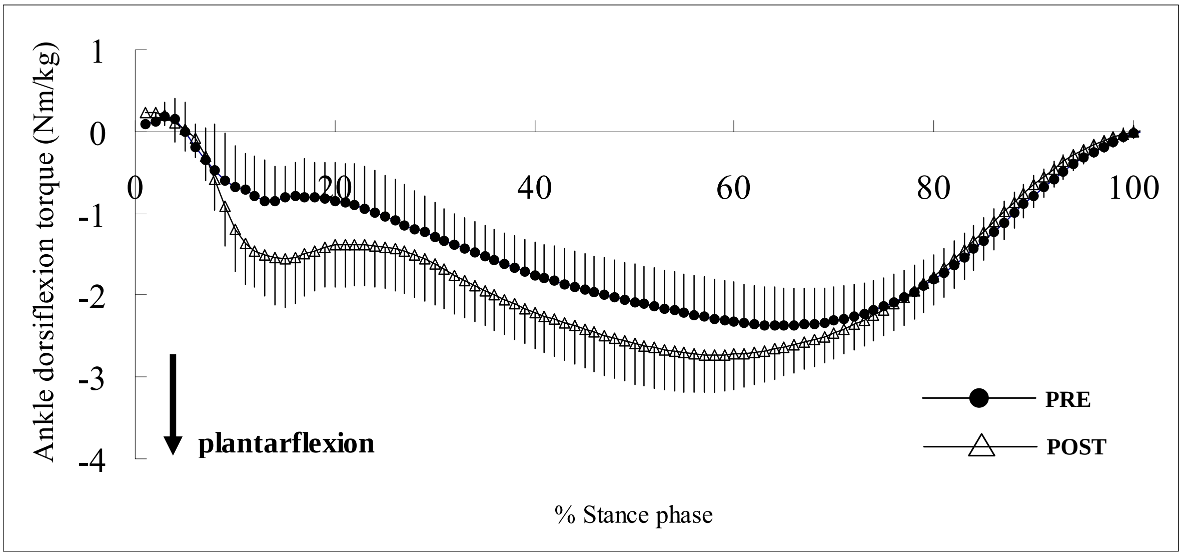

Figure 3: The ankle joint torque in the PRE (black circle) and POST (open triangle). Ankle plantar-flexion torque during 100 ms after foot contact in the POST was larger than in the PRE.

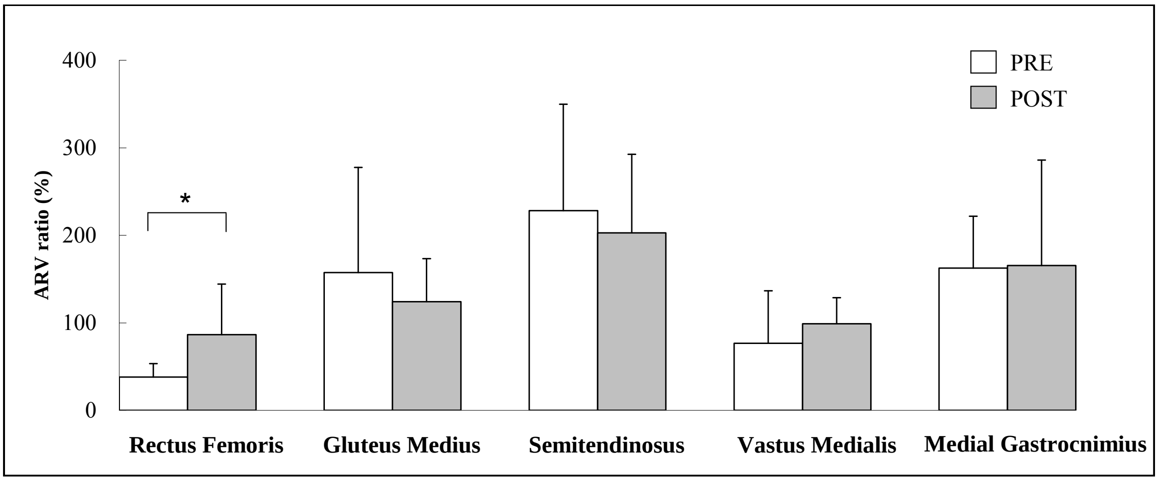

Figure 4: The ARV ratio in the PRE (open bar) and POST (coloured bar). "ARV ratio" was obtained by ARV value of EMG for 100 ms before foot contact divided by ARV value for 100 ms after foot contact. *denote significant differences between two conditions (α<0.05).

DISSCUSSION: In this study we investigated the effect of neuromuscular control training on a performance of the sidestep cut with a choice reaction task. Mean foot contact time in the POST was significantly shorter than in the PRE ($\alpha<0.05$), nevertheless mean running speed at touchdown and toe off was not significantly different between two conditions. The ARV ratio of the RF was significantly greater in the POST than in the PRE. These results suggest that the subjects reacted earlier in the POST than in the PRE. Horita et al. (2002) suggested that the pre-activity of knee extensors could enhance the following drop jump performance. In this study subjects could perform the sidestep cut in shorter time with a pre-activity of the RF. Mean peak ankle plantar-flexion torque for 100 ms after the foot contact in the POST was significantly greater than in the PRE. The training for neuromuscular control of the choice reaction tasks could contribute to make subjects to adjust appropriate activation strategies in a short time.

CONCLUSION: In this study the training for neuromuscular control of the choice reaction tasks made subjects adjusted appropriate activation strategies for sidestep cut in shorter time. The results of this study suggest that the training for neuromuscular control was effective for enhancing the sidestep cut performance. The person with faster reaction ability is clearly advantageous to others in real match situation. We encourage the neuromuscular control training for the ball game players who have to react quickly to several game situations.

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