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GRF with backward turn and the acceleration with a counter step of male soccer players

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INTRODUCTION

A victory in the soccer game is caused by blocking own goal in their defense phase as well as scoring. In order to keep an offense player outside from the goal, a strategy with one side cut position against the attack player is generally used by the defense player. Therefore, in the defense phase, a motor task which changes the movement course behind and accelerates into the direction according to the movement of an offense player is a key for defense players to block their goal.

Because of shortening the sprinting time, beginning of the motion with a counter step is more effective movement compared to that with a side step [1]. It has been reported that this faster sprint time with a counter step was caused mainly by the shorter stance time at the first step, and was not caused by the ground reaction force (GRF) impulse. However, this beginning of motion did not involve the backward turn, and cannot directly apply to the above-mentioned defense movement.

Therefore, the purpose of this study was to investigate that comparing the sprinting time and the GRF data of the soccer player between the beginning movement with backward turn using a counter step and that using a side step from one side cut position.

METHODS

Fourteen male university soccer players (age = 21.1 ± 1.5 yr, height = 171.8 ± 4.4 cm, body mass = 67.8 ± 4.7 kg, mean ± standard deviation [S.D.]) was participated in this study. All of the participants were the defense players in right side position. Participants conducted a general warm-up comprising 10 minutes of jogging and dynamic stretching. Five 3-m sprinting dash with a backward turn using a counter step and a side step was performed. Three practices for each experimental trial with the submaximal effort were performed prior to the experiment. The start posture was operated with bending their hip joint and with one side cut position toward right side was made to incline forward. The rest between experimental trials was 90 s.

The backward turn and sprint time up to a distance of 3-m was recoded with the photo-electronic sensors. The 3D locations of 48 retro-reflective markers attached to the participants' whole-bodies were measured using a 16-camera motion capture system for the displacement of the

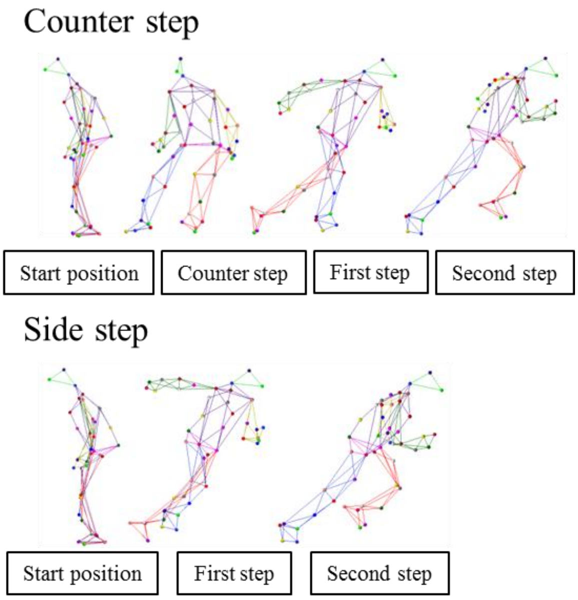

Figure 1: The experimental trials with the counter and side steps.

center of mass and foot trace data (Raptor-E digital; Motion Analysis Corporation, Santa Rosa, CA). GRF data at the first and second steps were captured with 2 x 3 aligned force plates (TF-4060-B, Tech Gihan Corporation, Kyoto, Japan). We calculated the mean value of anterior GRF and the anterior impulse. So as to examine the differences between the two steps of players t-test was used. The effect size was calculated by Cohen's method. The statistical significance of all tests was set at $p < 0.05$.

RESULTS and DISCUSSION

The major finding in this study was that the 3-m time with backward turn from a counter step was faster than that from a side step (Table 1). From our findings, however, it was not clear that why the backward turn from a counter step was able to shorten the 3-m sprint time.

Although the anterior impulse at the first step in the counter step trial was significantly larger than that in the side step trial, the stance time at the first step was longer than that in the side step. Sprinting velocity is directly determined by anterior impulse normalized by body weight and because the impulse is equal to the product of force and time, increased sprinting velocity can thus be caused by an increase in the propulsive force generated or an increased push duration.

Spending a longer time in the first conflicts with the least possible time nature of a sprint. Thus, it would not be beneficial for overall sprint time.

Moreover, in the counter step trial, the anterior displacement of both center of mass and foot on the ground from the start position was closer to the start position compared to that in the side step. This suggests that the beginning of movement with backward turn from the counter step has a disadvantage for approaching the attack player with more steps. Further investigation is needed the mechanics of the faster sprint time with backward turn from a counter step focusing on its step movement and GRF.

CONCLUSION

The counter step is effective in the backward turn movement in a defense phase. However, we cannot explain that why the backward turn from a counter step was able to shorten the 3-m sprint time by analyzing only GRF at the first and second steps.

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Table 1: Mean (S.D.) measurement parameters from the counter and side steps.

	Counter step	Side step	Size effect
3-m sprint time (s)	1.45 (0.16)**	1.57 (0.14)	0.68
Stance Time (s)			
First step	0.26 (0.04)**	0.23 (0.03)	0.74
Second step	0.18 (0.02)	0.19 (0.02)	0.29
Anterior displacement of center of mass from the start position (m)			
First step	0.44 (0.12)***	0.77 (0.12)	0.91
Second step	1.30 (0.19)***	1.59 (0.27)	0.83
Anterior displacement of foot on the ground from the start position (m)			
First step	0.12 (0.15)***	0.45 (0.14)	0.89
Second step	0.94 (0.19)***	1.22 (0.27)	0.81
Mean anterior GRF (N/bw)			
First step	0.51 (0.05)	0.53 (0.05)	0.46
Second step	0.48 (0.06)	0.49 (0.06)	0.25
Anterior Impulse (Ns/bw)			
First step	0.13 (0.02)*	0.12 (0.01)	0.55
Second step	0.09 (0.01)	0.09 (0.01)	0.45

*Significantly different at $p < 0.05$, **Significantly different at $p < 0.005$, ***Significantly different at $p < 0.0005$.