KINEMATICS OF SOCCER DRIBBLING IN DIFFERENT TASKS

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The purpose of this study was to find the differences in kinematics between different speeds and cutting directions. Ten male university division 1 soccer players served as the subjects in this study. The Vicon Motion System and the KISTLER force platform were used synchronously to collect data. The length of projection vector was normalized by leg length. 2way ANOVA was used for statistics. Simple main effect was tested if no significant interaction effect was noted. The significant level was set as .05. The length of projection vector between COM and the heel of pivot leg onto X-Y plane in high speed tasks were longer than that in low speed tasks (p < .05). The angle between the X axis and the projection vector between COM and the heel of pivot leg onto X-Y plane had significant interaction effect (p < .05). In low speed tasks, players' pivot legs landed more laterally and that might enhance lateral motion of body, especially when players cut to the dominate side (right). It was concluded that players would change their cutting tactics at different speeds and in different directions. Landing position of pivot leg might be a factor that would help defender to know the cutting side of attacker at low dribbling speed.

KEY WORDS: cutting, motion analysis, center of mass.

INTRODUCTION: Cutting with dribbling is one of the most basic skills in soccer. Space can be created by successful dribbling and player can also have more tactical chooses for attacking. For the defensive side, "how to stop attacking players?" could be an important issue in soccer games (Hargreaves & Bate, 2010; Hughes, 1994). In a one-on-one situation, if the defensive player knows the cutting direction of attacker earlier, players would have more opportunity to get the ball. Like gait cycle, basic dribbling without obstacle is a repeat motion. Body motion would change to prepare for changing direction before cutting and defender would use the differences to speculate about opponent's next movement. Before our test, we interview 19 division one soccer players and fined that over 70% players speculate about attacker's cutting direction by ball and the motion of feet in one-on-one situation. Center of mass (COM) would stand for the positon of full body. We used L_{CH} (the length of projection vector between COM and the heel of pivot leg onto X-Y plane) and A_{CH} (the angle between the X axis and the projection vector between COM and the heel of pivot leg onto X-Y plane) to stand for the landing position. Speed and direction may be the factors that would relate to motional differences. For the above reasons, the purpose of this study was to find the landing position difference between different speeds and different cutting directions. In this research, we observed the final step before cutting and hoping the result could give some suggestion to players.

METHODS: Ten male university division 1 soccer players (height: 172.7 ± 5.0 cm, weight: 69.1 ± 8.6 kg, age: 19.1 ± 2.3 years, dominate leg: right leg) served as the subjects in this study. All subjects were no neuromuscular disease, injury or pain, and signed informed consent before participating. Ten Vicon cameras (Vicon MX13+, Oxford Metrics Ltd., England, 250 Hz) were used to collect the kinematics data and the force platform (Kistler 9187, Winterthur, Switzerland, 1500 Hz) was used synchronously to collect kinetics data. Plug-in Gait marker set was used to define the coordination of segments. Before doing tasks, participants had to practices at least five times to familiarise themselves with the situation. Every player had to follow the direction under anticipated, and cut with dribbling (Figure 1). Subjects had to cut with dribbling at high speed and low speed in different directions. In low speed task, we ask participants to dribbling like normal practice. And in high speed task, we ask participants to dribbling as fast as possible. When players cut to the right, the left leg should land on the force platform (pivot leg was left leg). Conversely, the right leg should land on the force platform when cutting to the left (pivot leg was right leg). Visual3D v4 (C-motion Inc., USA) was used to analyse the data, and kinematics data were smoothed with a Butterworth fourth-order low-pass filter (cut off frequency: 6Hz). The length of projection vector was normalized by leg length. 2way ANOVA, dependent samples will be used to test the length of projection vector between COM and the heel of pivot leg onto X-Y plane (L_{CH}) and the angle between the X axis and the projection vector between COM and the heel of pivot leg onto X-Y plane (A_{CH}, Figure 2). If there was no significant interaction effect, simple main effect will be tested. The significant level (α value) is set as .05. LSD was used for post hoc.

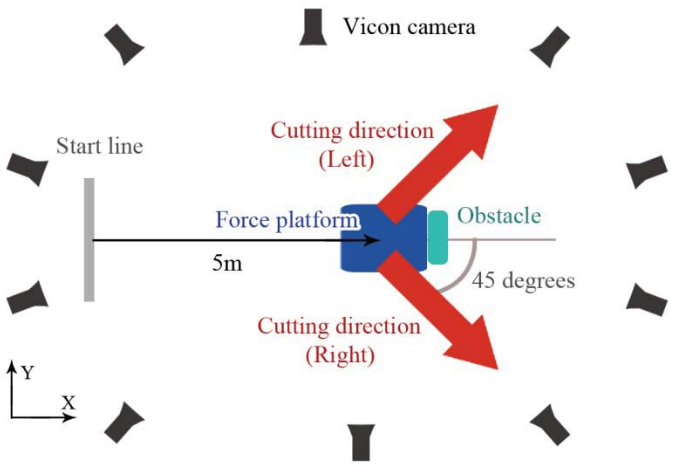

Figure 1: Experimental environment.

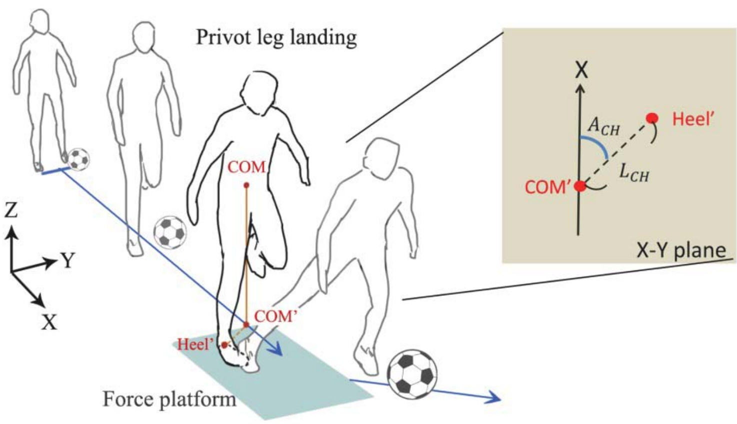

Figure 2: The definition of L_{CH} and A_{CH}. L_{CH} was the length of projection vector between COM and the heel of pivot leg onto X-Y plane when pivot leg landing. A_{CH} was the angle between the X axis (dribbling direction before cutting) and the projection vector between COM and the heel of pivot leg onto X-Y plane when pivot leg landing. Direction of X axis is the dribbling direction before cutting.

RESULTS: The length of projection vector between COM and the heel of pivot leg onto X-Y plane at in different task had no significant interaction effect. But L_{CH} in high speed tasks were longer than L_{CH} in low speed tasks (p < .05). The angle between the X axis and the projection vector between COM and the heel of pivot leg onto X-Y plane had significant interaction effect (p < .05, Table 2), and A_{CH} in right at low speed is largest.

Table 1
Instantaneous speed when pivot leg landing in different direction, mean(SD).

	High speed (m/s)	Low speed (m/s)
Right*	3.6 (0.2)	3.0 (0.2)
Left*	3.5 (0.2)	3.0 (0.3)

* significant different between two speeds, $p < .05$

Table 2
L_{CH} and A_{CH} in different task, mean(SD).

	Low speed		High speed	
	Right	Left	Right	Left
L_{CH} (%)[a]	41.9 (8.7)	44.2 (10.1)	46.7 (6.3)	47.3 (8.7)
A_{CH} (degree)*	51.6 (12.7)	45.6(10.4)	41.7 (12.9)	43.9 (10.3)

* significant interaction, $p < .05$
[a] significant different between two speeds, $p < .05$
[b] significant different between two tasks, $p < .05$

DISCUSSION:

In high speed tasks, players increased step length to promote dribbling speed. Players had different cutting performances in different tasks when pivot legs were landing. In low speed tasks, players' pivot legs landed more laterally and that might enhance lateral motion of body for cutting, especially when players cut to the dominate side (right). In contrast to low speed tasks, players had less lateral motion in high speed tasks. When player cut at high speed, they might use beneficial velocity to dribbling past opponents. Nagano, Kato and Fukuda (2004) used visual search to know the strategies of soccer players in one-on-one defensive situations and find that the importance in soccer for players to focus not to focus on the ball, but on an opponent's knee and hip. In our study, feet could be one of the hints to presume attacker's cutting direction especially when attacker dribbling at high speed.

CONCLUSION:

Players could change their cutting tactics at different speeds and in different directions. Landing position of pivot leg might be a factor that would help defender to know the cutting side of attacker at low dribbling speed.

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