KINEMATIC ANALYSIS OF LOWER LIMB IN FUTSAL BALL KICKING

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INTRODUCTION: The diameter of the futsal ball (200 mm) is smaller than that of the soccer ball by 20 mm, and the futsal ball also has lower resilience than the soccer ball. Because of these differences in the balls, it is thought that the kicking motions of futsal players are distinct from those of soccer players. No study has yet been conducted on the motion involved in kicking a futsal ball. The aim of this study was to clarify the difference between the motion involved in kicking the futsal ball with that involved in kicking the soccer ball.

MERHODS: The study population comprised 9 male professional futsal players who were instructed to kick a futsal ball and a soccer ball with maximum effort, using instep kicks. All the subjects kicked the balls at least 5 times, and the shot that involved maximal initial velocity was selected for further analysis. Three synchronized high-speed cameras (250fps) were used to record lower limb motion during the kicking. A digitizing system was used to manually digitize anatomical landmarks and the balls on the images recorded by these 3 cameras. Using these digitized data, we calculated the angle of the pelvis (defined as the vector from the left hip to the right hip and relative to the anterior direction within the horizontal plane), angle of the thigh-shank plane (defined as the vector normal to and pointing outward from the thigh-shank plane and relative to the anterior direction within the horizontal plane), initial ball velocity, foot velocity, and ball velocity-foot velocity ratio for both types of balls.

RESULTS: The values for initial ball velocity, foot velocity, and ball velocity-foot velocity ratio for all participants are shown in Table1. The mean initial ball velocity and mean ball velocity-foot velocity ratio for the soccer ball were significantly greater than those for the futsal ball. No significant difference was observed between the mean foot velocity when the soccer ball was kicked and that when the futsal ball was kicked. The mean (SD) angles of the pelvis and the thigh-shank plane are shown in Figure1. The mean (SD) changes in the horizontal angles of the pelvis and the thigh-shank plane were similar when both balls were kicked, with no significant difference in the kicking motions.

DISCUSSION: The mean velocity of the soccer ball was similar to those recorded in previous studies on professional soccer players. The results suggested that the kicking performance of professional futsal players is as good as that of professional soccer players. No significant difference was observed between soccer and futsal kicking with regard to the angle of the pelvis and that of the thigh-shank plane. This may indicate that the participants kicked both balls with the same kicking motion. The angles of the pelvis and thigh-shank plane during instep and side-foot soccer kicking have been reported previously. In these studies, the horizontal angle of the pelvis was 105° in instep kicking and 120° in side-foot kicking approximately before the impact, and the horizontal angle of the thigh-shank plane was reported as 92° in instep kicking and 130° in side-foot kicking approximately. The kicking motions of the futsal players were thought to exhibit characteristics of both instep and side-foot kicking, as seen in soccer players. Further, the recorded thigh-shank plane angle also suggested that these subjects kicked the balls at a little inside of the foot. This action results in good impact of the foot on the ball and can be effected by decreasing the positive extension of the foot joint.

Table.1: Initial ball velocities, foot velocities and ball-foot velocity ratios

	Initial ball velocity (m/s)		Foot velocity (m/s)		Ball-foot velocity ratio	
Sub.	Soccer	Futsal	Soccer	Futsal	Soccer	Futsal
A	29.9	27.6	20.5	19.3	1.46	1.43
B	28.3	26.8	19.2	20.7	1.47	1.30
C	30.9	28.2	19.3	20.5	1.60	1.38
D	27.1	24.3	18.6	18.1	1.46	1.34
E	29.7	27.0	20.2	21.7	1.47	1.25
F	28.5	26.1	18.0	18.8	1.59	1.39
G	24.4	23.1	16.2	17.4	1.50	1.32
H	26.3	26.0	18.5	20.0	1.42	1.30
I	27.4	25.4	19.2	18.8	1.43	1.36
Mean	28.1	26.0	18.9	19.5	1.49	1.34
SD	2.0	** 1.6	1.3	1.4	0.06	* 0.06

* Shows significant differnce ($p<.05$)
** Shows significant differnce ($p<.01$)

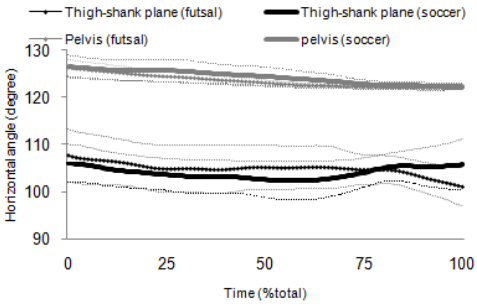

Figure.1: The mean changes and SD for the horizontal angle of pelvis and thigh-shank plane. Time for the leg-aceleration tarm was normalized to 100%.

CONCLUSION: The aim of this study was to clarify the motion involved in kicking a futsal ball. The results show that the kicking performance of professional futsal players is as good as that of professional soccer players. On comparing our results with those of previous studies, we observed that the maximum-effort motion involved in kicking the futsal ball had the characteristics of both instep kicking and side-foot kicking, as seen in soccer players. Futsal coaches training players for powerful kicking should advise the players to use a combination of soccer-style instep kicking and futsal-style side-foot kicking.

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