FOOT MOVEMENT IN IMPACT PHASE OF INSTEP KICKING IN SOCCER

Hironari Shinkai, Hiroyuki Nunome*, Yasuo Ikegami* and Masanori Isokawa

Department of Kinesiology, Tokyo Metropolitan University, Tokyo, Japan
*** Research Centre of Health, Physical Fitness, and Sports, Nagoya University, Nagoya, Japan**

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INTRODUCTION: Ball impact technique is essential to produce a higher ball velocity in soccer instep kicking. However, to date only a few studies focused on foot kinematics during ball impact, in which plantar flexion motion of the foot was solely reported (Asai et al., 1995; Nunome et al., 2006). In this study, three-dimensional movement of the foot (plantar flexion / dorsal flexion, abduction / adduction, eversion / inversion) during ball impact was quantified to extract some movement characteristics releted to a higher ball velocity.

METHOD: Six experienced male soccer players participated in this study. They performed several types of maximum instep kicking with various ball contact positions on the foot. The foot and shank motions during ball impact were recorded using two ultra high-speed cameras (MEMRECAM fx6000, nac, Inc., Tokyo, Japan) at 5000fps. The three-dimensional movement of the foot was calculated from the local coordinate system fixed on each segment.

RESULTS: The average ball velocity was 29.8±1.2 $m \cdot s^{-1}$ and the average ball-foot velocity ratio was 1.40±0.9. During ball impact, the largest angular displacement was observed for plantar flexion motion and the smallest was represented for abduction motion (Table 1).

Table 1 Angular displacement of foot during the impact ($deg \cdot s^{-1}$)

	35 trials(mean±s)	highest ball-foot velocity ratio trial
plantar flexion(-)/dorsal flexion(+)	-8.1±6.6	0.5
abduction(-)/adduction(+)	-1.7±2.7	-2.8
eversion(-)/inversion(+)	-4.1±3.1	-3.3

DISCUSSION: In case of the highest ball-foot velocity ratio trial (1.55), the foot did not forced into plantar flexion but into slight dorsal flexion during ball impact because the ball contact position was quite close to the ankle. From this case, it can be suggested that as the ball reaction force vector passed near the mass center of the foot, passive plantar flexion motion was restrained during ball impact. There was a consistent trend among all participants that the foot was more inclined horizontally to hit the ball close to the ankle thereby achieving a higher ball-foot velocity ratio.

CONCLUSION: The foot forced into plantar flexion, abduction and eversion during ball impact phase of the instep kicking. As the foot is easily forced to be plantary flexed thereby spoiling the quality of ball impact, restraining this motion duirng ball impact can be an essential to kick the ball efficiently. Moreover, horizontally inclined foot against the ball may serve a likely configuration of the foot.

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