HOW TO PRODUCE NON-SPINNING “BUTTERFLY BALL”

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In recent years, kicking the ball with none or very low spinning has been widely recognized as an effective technique to score the goal in soccer. To date, several studies have been made on the aerodynamic property to explain “why those ball flies irregularly like butterfly”. On the other hands, it remains unclear “how to produce such ball”.

To reveal this matter, our research group studied biomechanical characteristics of the butterfly shot kicked by a Japanese top footballer who is a member of national squad and is well known as a good kicker of that shot. His kicking motion during ball impact was captured by two ultra-high-speed cameras at 2000 fps. From these images, three-dimensional motion of the kicking foot during ball impact was obtained. The foot angular kinematics (plantar/dorsal flexion, adduction/abduction, inversion/eversion) and contact point with the ball were compared with those of the straight forward shot (with back spin) produced by the instep kicking.

As shown in Figure 1, the kicking foot was appreciably forced into plantar flexion, abduction, and eversion during ball impact of the straight forward shot. These passive foot motions, by gear effect, induce some spin on the ball (mainly back spin). In contrast, those motions of the butterfly shot were restricted evidently compared to those of the straight forward shot.

In the case of the butterfly shot, the player impacted the ball with the medial and proximal part of the foot, which can be said as a hybrid position between the instep and side-foot kicking. This unique technique may allow the player to restrict the passive foot motions, because the ball reaction force vector would act closer to the foot centre of gravity.

One top player demonstrated a very reasonable and simple technique to successfully produce butterfly shot.

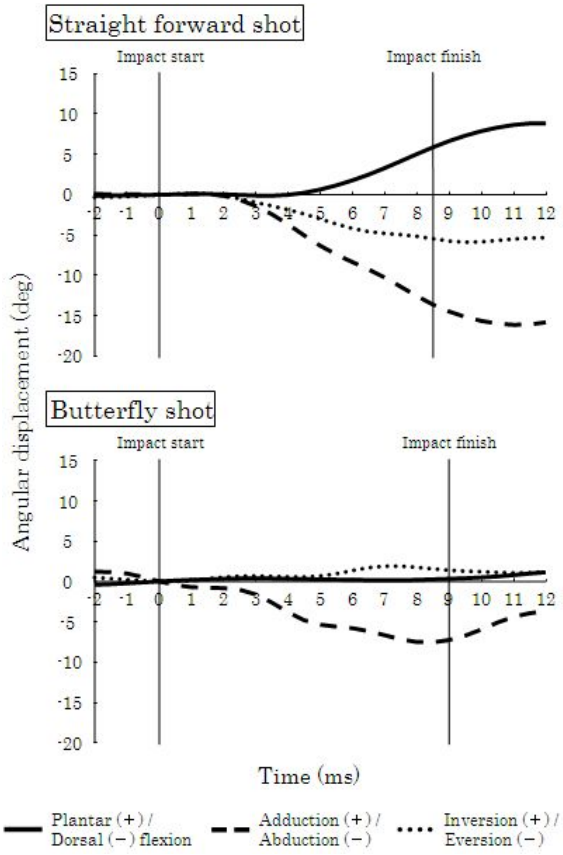

Figure1. 3D angular displacements of the foot during ball impact in instep (top) and knuckle ball (bottom) kicking.