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A Novel Method to Measure Biomechanical Parameters of Soccer Kicks and Two-Footedness in the Field

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Abstract. There is some consensus that two-footed play is associated with skill in individual players. In sports biomechanics, videography provided an indirect method for measuring kinematic parameters. However, these techniques are expensive, bulky and not portable. The current system is applicable in sports that involve high linear and rotational kinematics and high impact contact with the ball.
A novel sensor module mounted on a soccer shin guard and small data logger were previously designed and validated (Meamarbashi, 2007). This design is able to record the linear and rotational movements in three axes as well as thigh linear kinematics at 200 Hz and save the data on a memory card. A custom PC software was developed to measure the high kinematic parameters (linear and angular accelerations and velocities) and compute the kinetic parameters (force, torque, angular momentum, impulse and angular power) of the instep kick and compare the right and left legs during trials of a subject or in the group. In this study, leg movement patterns of the subject legs investigated in compare to others. This novel technique is suitable in Soccer, Rugby, American Football, Tennis, etc to evaluate the player's right and left legs in the field.

Key Words: Instep Kick, Data Logger, Leg Movement Pattern, Two-Footedness, Soccer

1. Introduction

Soccer is the most popular sport in the World. Knowledge and analyze the biomechanical parameters improves soccer skills. Three dimensional data recording of the biomechanical parameters providing sufficient information regarding this technique and comparison of the player in the group is possible. The instep kick mostly used and it was subject to the two and three dimensional videography techniques (Asai et al., 2002; Shan and Westerhoff, 2005; Nunome et al., 2006). In professional soccer players, equal kicking performance for both legs is desirable. However, soccer players kick with a higher speed and more accurately with their preferred leg than with their non-preferred leg (Van Deursen & Klous, 2001). Today, study of soccer skills mostly investigated by videography to measure the leg kinematics or by radar gun to determine the ball speed. To the best of our knowledge, no direct measurement technique was used to study of the high kinematics of the soccer instep kick. In the previous researches, comparison of the leg movement patterns was not concerned. The group graphical kinematic data in different axes could be used for the overall and personal evaluation of an skill. This method is valuable to improve the skill and identify the neuromuscular problems via training and retests.

2. Methodology

This project was a semi-experimental study on one group soccer player. Fifteen university soccer players with right leg preferred were recruited. First, anthropometric parameters (height, weight, BMI, foot, shank and leg lengths) were measured. After 10 min warm-up in the soccer field, a sensor module and data logger were attached to the shank and middle of thigh. They were performed four instep kicks with 45° with right (preferred) leg and later with left (non-preferred) leg then recorded data on a memory card was transferred to computer for computation of kinematic (linear and angular accelerations and velocities) and the kinetic parameters (force, torque, angular momentum, impulse and angular power). Independent Student T-Test was used to compare the differences between the means and level of significance was set at 0.05.

3. Results

Maximum shank angular velocity of X and Z axes in preferred and non-preferred legs were 1865±201, 1498±345 and 516±385, 559±375 °/s, respectively. Results showed significant difference between preferred and non-preferred legs in X and Z-axis. Angular velocity of the left leg in Z-axis was 295.8% higher than the right leg. This was indicated high leg abduction and necessity for technical improvement. Angular velocity of the left leg in X-axis was 19.9% lower than the right leg. Change in these parameters needs training programs. The plots of the angular velocities indicate the leg movement pattern in the group and abnormal players.

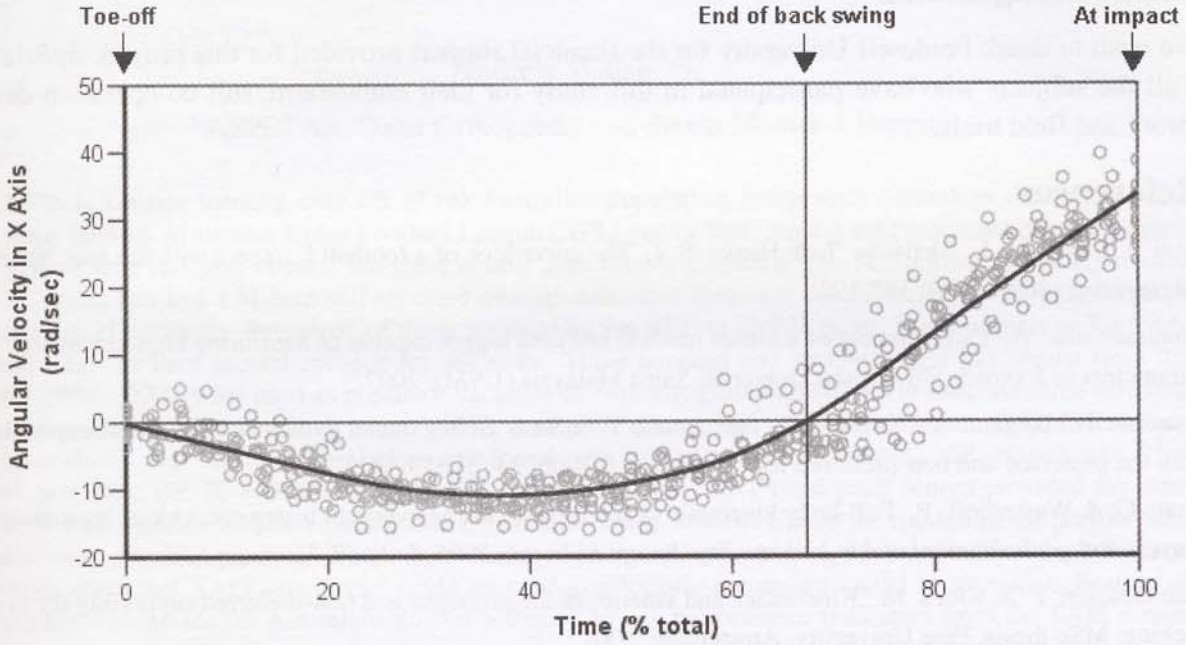
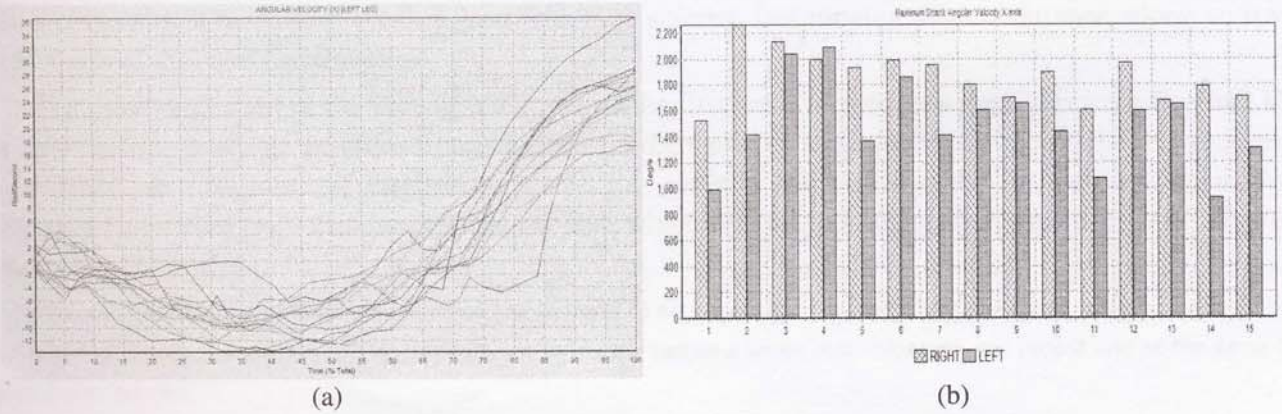


Figure 1: Shank angular velocity in X-axis in the group (fifteen players)

Comparison of the right and left leg kinematic or kinetic parameters can be evaluated by bar graph (Fig. 2.b). Another utility of the software is demonstration of the kinematic data of the subjects in a line graph normalized from toe-off until impact with the ball in time percent (Fig. 2.a) for the dominant or non-dominant leg.



(a) (b)

Fig. 2: Cumulative (a) and comparison of (b) data from fifteen subjects

4. Discussion

The result was indicated similarities in the shank angular velocity pattern compare with Nunome (2006) and Wickstrom (1957) findings. Those with different leg kinematics were also different in the movement patterns in X and Z axes. This method provided a rapid evaluation in the field for the coaches to understand the player's skill level and correct them. Kinematic and kinetic comparison can be used to improve training programs and players skill level. This technique is not restricted to the soccer. It is applicable in Rugby, American Football and Tennis.

5. Acknowledgements

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