BIOMECHANICAL CLASSIFICATION OF TAEKWONDO KICKS

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INTRODUCTION

Taekwondo is one of the martial arts and is so popular that it has been an official Olympic event from the 2000 Olympics in Sydney. The popularity of Taekwondo mainly comes from its dynamic kicks during sparring. There are many kinds of kicking techniques in Taekwondo, such as front kick, roundhouse kick, side kick, back kick, swing kick, hook kick, back spinning hook kick, and axe kick, depending on the plane of movement and joint action of lower extremities.

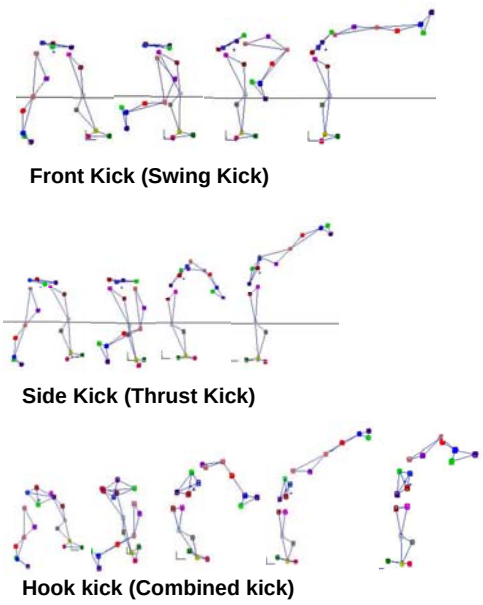

Figure 1: Graphical representation of three style kicks in Taekwondo.

There are a few biomechanical studies on front kick and roundhouse kick but the other styles of kicking have not been studied so far (Sorensen et al., 1996). The main goal of kicking is to hit a target correctly with decent power for getting points in sparring. Therefore, the fast and forceful kick is very important to reach high power of kicking. Even though there are various kicking techniques in Taekwondo, it is hypothesized that there are three distinctive styles of kicking depending on kinematic characteristics of kicking (see Figure 1). The swing kick is used to maximize the speed of the foot at impact. The thrust kick is used to generate large forces at impact. The combined kick is used to generate both a large speed and large forces.

The purpose of this study was to collect kinematic data of six different techniques of Taekwondo kick and to classify their patterns of kicks into three groups depending on their kinematic characteristics.

METHODS

Six subjects were recruited from the ASU Taekwondo club and off-campus Taekwondo schools. They had a minimum of three years of Taekwondo training and participated in practice on a regular basis.

Eighteen reflective markers were placed on the body segments and 10 CCD cameras (Motion Analysis System, Santa Rosa, CA, USA) with sampling rate of 200 Hz were used to record body marker position data.

Subjects were asked to execute randomly ordered six different kicks in the air and five trials for each kick. The six kicks were front kick (FR), roundhouse kick (RH), side kick (SD), back kick (BA), hook kick (HO), and back hook kick (BH).

Saved body position data were used for kinematic data analysis and pattern analysis following 2nd order zero-lag Butterworth filter (cutoff frequency 10 Hz). Repeated measures ANOVA on the maximum kicking speed of each kick were performed. Angle-angle plot for hip and knee flexion/extension angles were investigated.

RESULTS AND DISCUSSION

Roundhouse kick (RH) showed significantly higher speed (13.9 ± 0.72 m/s) than SD, BA, and HO. Side kick (SD) speed (8.55 ± 0.53 m/s) was significantly lower than FR and RH (see Figure 2).

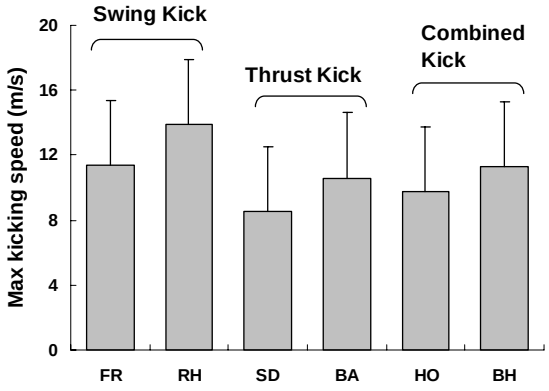

Figure 2: Swing kicks generally showed the highest kick speeds while the thrust kicks generally showed the lowest kick speeds.

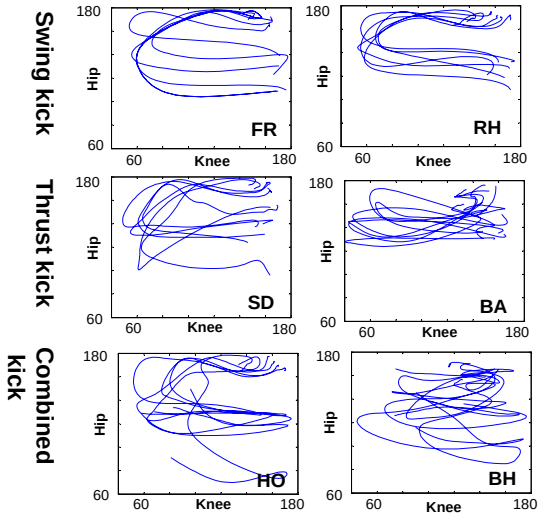

Figure 3: Angle-angle plot (hip-knee) indicates the complexity of the combined kick.

Overall mean of combined kick was between swing kick and thrust kick.

The angle-angle plot (hip flexion/extension–knee flexion/extension) showed the qualitative pattern of each kick and the complexity of movement of the kicking leg (see Figure 3). RH showed the consistency across individuals. Combined kick (HO and BH) indicated the complexity of joint movement.

SUMMARY/CONCLUSIONS

This study indicates that swing kicks (FR and RH) generally achieve the highest kicking speeds of all the types of Taekwondo kicks. The swing kicks use the open kinetic chain principle in an attempt to maximize the distal end linear velocity (Putnam, 1991). Hence, they have a velocity advantage in reaching high mechanical power. Thrust kicks (SD and BH) are performed by opposite torque directions between hip and knee joints to thrust the foot segment toward a target. They have lowest kicking velocities but force advantage due to co-activations of flexors and extensors at hip and knee joints. This indicates force advantage in generating kicking power. Combined kicks (HO and BH) have decent velocities as well as co-activations of flexor and extensor muscles. Therefore, they have both velocity and force advantages in power generation during kicking. However, the complexity of leg motion does not allow the beginners to learn them easily. The highest kicking speed and consistent pattern of angle-angle plot support the popularity of roundhouse kick (RH) among various kicks in Taekwondo.

REFERENCES

Putnam, C. (1991). *Med. Sci. Sport Exerc.*, **22**, 130-144.

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