THE SUPPORT LEG AND ATTACK PATTERN RELATIONSHIP OF BACK KICK MOVEMENT IN TAEKWONDO

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The purpose of this study is to investigate the relationship between the support leg and attack pattern for back kick during the attack phase. Seven male Taekowndo athletes（age: 21.0 ± 2.0 year old, height: 180.4 ± 4.4 cm, weight: 69.1 ± 26.1 kg）performed the back kick. The back kick motion was collected by two Redleke cameras (60Hz）. Kinematics data was analyzed by KWON 3D motion system. The accelerometer was fixed on a kicking bag（20kg）. Biovision system was used to recode acceleration value. The results indicated that the peak angular velocity of knee in the attack leg appear during the hitting to the kicking bag. The fighting type can divided attacking and counterattack pattern from support leg. In terms of moving distance of support leg, attacking pattern is significant loner than counterattack pattern. There was significant positive correlation among the angular velocity, force and movement distance. The study shows the support leg motion will influence the Taekwondo attack pattern and performance.

KEY WORDS: Taekwondo, Back Kick

INTRODUCTION:

Back kick is an important movement in the Taekwondo match. If back kick use in the right timing, it not only destroy the competitor's offensive also destroy the attack rhythm of competitor（Eddie, 1989; Lee, 1996）. Therefore, back kick is the best countermovement and an essential technique. According to biomechanical analysis, the knee's extension of attack leg is important. So, increasing knee range of motion of attack leg can create kicking force. What is support leg doing during the attack leg kick to the bag? However, back kick has different patterns in the match. The purpose of this study is to investigate the relationship between the support leg and attack pattern for back kick during the attack phase.

METHODS:

Seven male Taekowndo athletes (age: 21.0 ± 2.0 year old, height: 180.4 ± 4.4 cm, weight: 69.1 ± 26.1 kg）participated in this study. All subjects have experience of national competition. The main equipment included two Redleke cameras and Biovsion system which has an accelerometer. The back kick movement was collected by two Redleke cameras (60 Hz), and KWON 3D motion system was analyzed kinematics data. The accelerometer was fixed on kicking bag (20kg), and Biovsion system was used to recode acceleration and calculate the gravity value.

Back kick (Figure 1) was divided into the rotation, attack and restoration phases. However, in this study only analyzed the attack phase. Attack phase was defined as the minimum attack leg knee angle to straight leg. Contact phase was defined as the minimum attack leg knee angle to hit the bag. Kick phase was defined as a period of time from leg hit a bag to straight leg.

There are two patterns of back kick. Attacking pattern was defined as the support leg slid during attack phase. Counterattack pattern was defined as the support leg has a litter jumped during the attack phase. The subject performed the back kick three times. The data of the maximum gravity from three trials was analyzed. The parameters for this study are: knee angle and angular velocity of attack leg; percentage of moving distance which calculated by equation 1, knee angle and angular velocity of support leg, attack force. Attack force was a product of Bag mass and acceleration, and then it was normalized to body weight (BW).

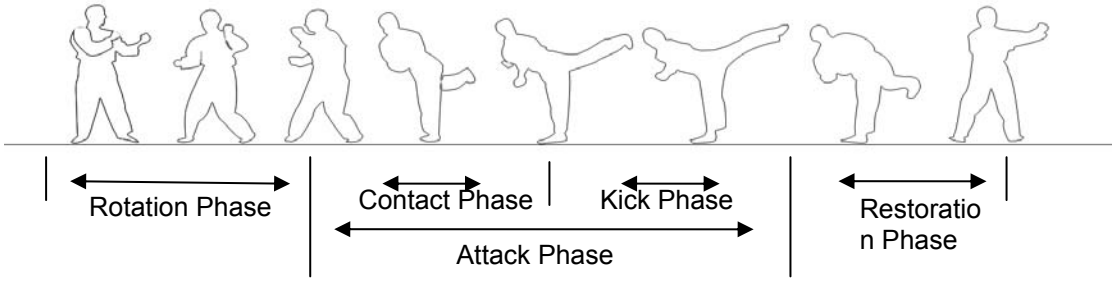

Figure 1: Illustration of Back Kick

$$Moving\ \ dis\tan ce\,(\%) = \frac{Toe's\ Postion\ \ Displacement\ of\ \ Support\ \ Leg}{Displacement\ of\ \ Toe's\ Postion\ to\ Bag\ \ Postion} \times 100\% \quad (1)$$

The t-test was used to determine the differences for parameters which were percentage of moving distance, angular velocity of attack leg and support leg between attacking pattern and counterattack pattern in back kick. Using Pearson correlation to find the attack force relationship with percentage of moving distance, angular velocity of attack leg and support leg about general, attack pattern and counterattack pattern. Statistical significance was set at 0.05.

RESULTS:

Back kick has two patterns in the study. Table 1 shows range of motion (ROM) of attack leg's knee, the peak angular velocity of attack leg and support leg.

Table 1 ROM of attack leg's knee, the peak angular velocity of attack leg and support leg

Pattern	Attack（N=3）		Counterattack（N=4）	
	M	SD	M	SD
Minimum angle of knee（deg）	61.5	6.6	58.6	4.7
Maximum angle of knee（deg）	152.5	21.4	152.9	9.2
ROM of knee（deg）	90.9	26.5	96.3	4.7
Knee's angular velocity of attack leg（deg/s）	926.1	249.3	977.8	135.5
Knee's angular velocity of support leg（deg/s）	180.1	153.5	58.2	32.8

Figure 2 shows attacking pattern between attack leg and support leg during attack phase. Figure 3 shows counterattack pattern between attack leg and support leg during attack phase.

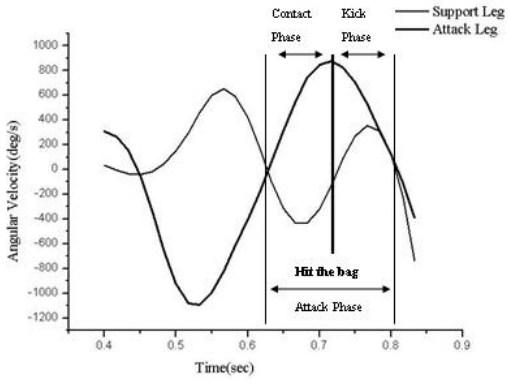

Figure 2: Attacking pattern

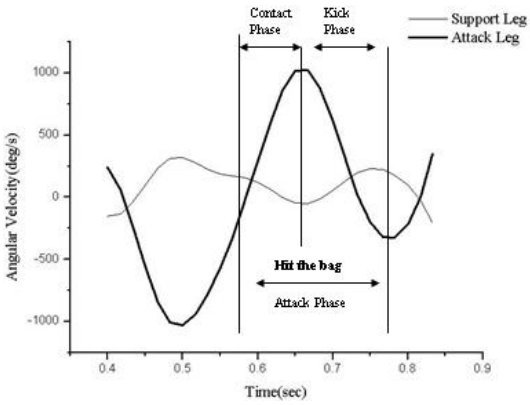

Figure 3: Counterattack pattern

The moving distance of support leg is different in two patterns. The moving distance of attacking pattern is more than counterattack pattern which differ approach 21.5% (Table 2). From t-test obtain the moving distance of attack pattern is great longer than counterattack pattern and other parameters have no significant (Table 3).

Table 2 Percentage of moving distance between attack pattern and counterattack pattern

	Attacking pattern（N=3）		Counterattack pattern（N=4）	
	M	SD	M	SD
Moving distance（%）	36.7	8.6	15.2	6.5

Table 3 The t-test of moving distance, angular velocity of attack leg and support leg between attacking pattern and counterattack pattern

Pattern	Attacking（N=3）		Counterattack（N=4）		
	M	SD	M	SD	t
Maximum angular velocity of attack leg in knee (deg/s)	926.1	249.3	977.8	135.5	-4
Minimum angular velocity of support leg in knee (deg/s)	180.1	153.5	58.2	32.8	1.6
Moving distance (%)	36.7	8.6	15.2	6.5	4.3*

*$p < .05$

The attack force, moving distance and angular velocity of support correlation between two patterns shows in Table 4.

Table 4 Pearson correlation of attack force, moving distance of support leg

	Angular velocity of support leg（deg/s）		
Pattern	General（N=7）	Attacking（N=3）	Counterattack（N=4）
Attack force（BW）	r = .9*	r = .8	r = .6
Moving distance（%）	r = .8*	r =.9*	r =.3

*$p < .05$

DISCUSSION:

There are fore subjects adopted counterattack pattern to kick. The support leg has jump upward. It can infer to the competitor is active attack which reduce the moving distance. Therefore, athletes control the attack distance and effect attack competitor. Another three subjects adopted attacking pattern. The support leg move more because attack distance is farer between competitor. Beside the moving distance difference between two patterns, the attacking pattern is great than counterattack pattern in the ROM and angular velocity of attack leg.

Figure 2 shows the angular velocity of attack leg and support leg in attacking pattern. During the contact phase, the peak angular velocity of knee in attack leg is hit the bag instantly. Due to support leg is slid to target; knee joint is bending in the landing. When knee start extension, the knee's angular velocity increase. During the kick phase, the knee's angular velocity decrease because the attack leg full extend which angular velocity transform to linear velocity. When support leg of knee start extension, after maximum angular velocity which stand for enter to the restoration phase happen. In counterattack pattern (Figure 3), the knee's angular velocity of attack leg is the same with attack pattern, but angular velocity of support leg is different. During the contact phase, when support leg landing which finish jump, the minimum knee's angular velocity happen in the attack leg hit the bag. The knee's angular velocity increasing is knee joint extension. The angular velocity curve of support is different between two kinds pattern.

Because the muscle strength have to balance for low limbs, the knee's angular velocity in two legs is no significant. Moving distance of attacking pattern is significant longer than counterattack pattern. Moreover, the moving distance can be an index divided into two

patterns of back kick. Angular velocity of support leg has positive significant correlation with attack force and moving distance for general. It infer to faster angular velocity of support leg can help attack force because knee joint extension may reduce the attack distance; moving longer may increasing attack leg's ROM of knee during kick phase. Angular velocity of support leg has positive significant correlation with moving distance for attack pattern. It infers to knee extension of support leg has close relationship with slip movement which influences knee's angular velocity. Angular velocity of support leg did not significant correlation with attack force and moving distance for counterattack pattern.

CONCLUSION:

In this study obtains that the support leg determines the back kick pattern and using timing. Support leg's moving distance influences the strategy and applying in the match. It is a reason why back kick is an important and indispensable movement in Taekwondo.

REFERENCES:

Eddie, F.（1989）. *TKEKWONDO-Traditional Art & Modern Sport*. Marlborough : Crowood.

Lee, K.M.（1996）. *Dynamic Taekwondo Kyorugi*. NJ : Hollym International Corp.

Putnam, C.A.（1993）. Sequential motion of body segments in striking and throwing skill：Descriptions and explanations. *Journal of Biomechanics*, 26（Suppl. 1）：125-35.