

## BIOMECHANICAL ANALYSIS ON ROUNDHOUSE KICK IN TAEKWONDO

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Taking a part of athletes of Taekwondo in Wuhan Institute of Physical Education as subjects, this study employed "Fighting Event-related Group Training Testing Machine" to get important athletes' data of roundhouse kick. In point of biomechanical view, it's easy to draw a conclusion that kick force (F) and kick velocity (V) were different about the front and back roundhouse kick when the suspended targets were at the angles of 90° and 110°. Therefore the purpose of this article was to draw its biomechanical characteristics and provide theoretic basis for teaching and training of Taekwondo.

**KEY WORDS:** taekwondo, roundhouse kick, biomechanics

**INTRODUCTION:** It is widely acknowledged that the Taekwondo's technological action is legs and with the hands of the accessory action. However during the use of Taekwondo leg action analysis, the most popular action is roundhouse kick which is the main attacking method. It's very simply that roundhouse kick is easier, speedier and more powerful than other leg action and it's also easy to attack and hard to defend, so it's very effective. From the important parameters on Taekwondo's aggressive action which includes hitting, strength, velocity and explosive forces, we can see roundhouse kick is one of the most useful action. So it is especially important that we analyze and appraise the roundhouse kick and study its inner characteristics and rules, hence we can direct the training and teaching scientifically.

**METHODS:** 15 athletes who are not suffering from any diseases or injury were chosen as subjects from the Taekwondo team of Wuhan Institute of Physical Education. Among them there are 6 male men and 9 female women, weighted from 47 to 85 kg. "Fighting event-related group training testing machine", which was developed by Wuhan Institute of Physical Education in the year 2000, is an instrument which can measure the data of the fighting event-related group, such as force and velocity. We employed this machine to get the athletes' kick force (F), kick velocity (V) and some other biomechanical data of the front and back roundhouse kick when the suspended targets were at the angles of 90° and 110°. And then these data were analyzed and studied.

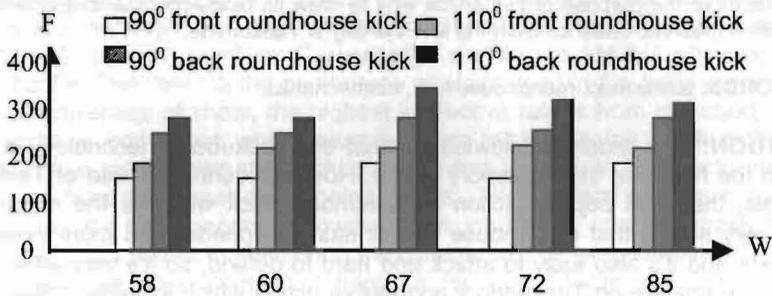
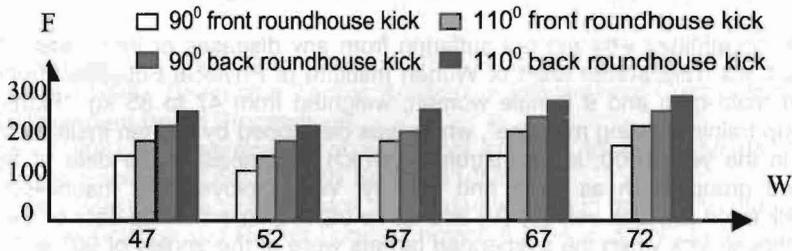
### RESULTS AND DISCUSSION:

**Characteristic analysis on roundhouse kicking velocity:** From the roundhouse kicking force parameters, we can see when the athletes attacked suspended targets which were at the angle of 90° and 110°, its kicking force was obviously different. The statistic figures are in below Table 1.

From the bar Figure 1 and bar Figure 2, we can see; different male and female athletes with different weight have different kicking force when using front and back roundhouse kick to hit the 90° and 110° targets. That is, the front roundhouse kick hitting the 90° target has the least force; the back roundhouse kick hitting the 110° target has the most powerful force. While the back roundhouse kick hitting the 90° target has more powerful force than the front roundhouse kick hitting the 110° target.

**Table 1 Kick forces of roundhouse kick leg (kg).**

Male (58~85 kg)				Female (47~72 kg)			
Front roundhouse kick		Back roundhouse kick		Front roundhouse kick		Back roundhouse kick	
90°	110°	90°	110°	90°	110°	90°	110°
144 ~ 213	188 ~ 245	241~ 300	275 ~ 357	107 ~ 183	122 ~ 230	162 ~ 245	214 ~ 300

**Figure 1 Kick forces of male roundhouse kick leg.****Figure 2 Kick forces of female roundhouse kick leg.**

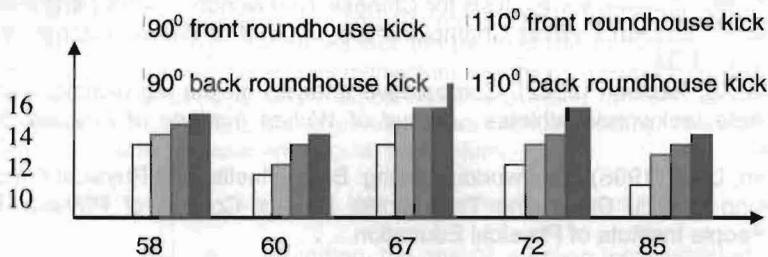
From the above kicking force characteristics, we can conclude the following reasons: First, the design of front roundhouse kick is different from that of back roundhouse kick, which leads to the differences of the shrink extents, time and initial condition of the involved muscular groups. The involved muscular group in back roundhouse kick shrink and extend more greatly with a longer time, what's more, the attacking leg has already had a certain acceleration when doing the action of whipping while the knee joints finish the inner kicking action, so the kicking force of the back roundhouse kick is obviously larger than that of the front roundhouse kick. Second, the back roundhouse kick's attacking routs do not always parallel absolutely the water level but move on the slope, so the muscular groups involved in the attacking leg are in the normal situation of shrink. However, when the front roundhouse kick is given, the slope of involved shank muscles is comparatively lower and there are more or less twists happened to muscles of hip and joints. And the movements of knee joint's clasp inward and shank's kick are almost started from a static state, which limits the exertion of the kicking force of the attacking leg. Third, the kicking force of the attacking leg in back roundhouse kick is vertically contacted with the opponent's body, so the forces won't be weakened. While there exists certain angle when contracted with opponent's body in front roundhouse kick, which surely will weaken the kicking force, thus reduce the efficiency of the kick.

**Characteristic velocity analyses on roundhouse kicking force:** From the below Table 2 and bar Figure 3 and bar Figure 4, it's easy to get a conclusion: No matter what angle the suspended target is at the kicking velocity of the male and female athletes show great

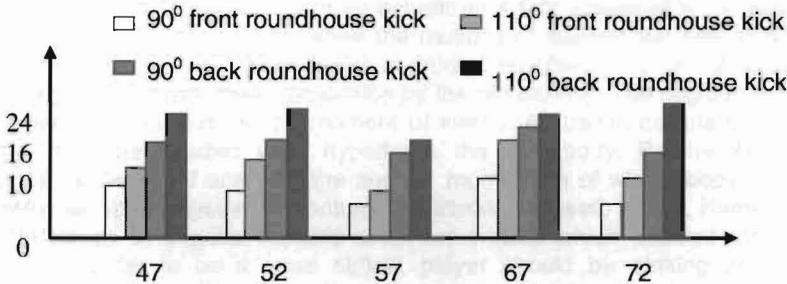
differences in front and back roundhouse kick, and the relation between velocity and the athlete's weight is not the absolute lineal on the whole.

**Table 2 Parameters of kick velocity roundhouse kick leg (m/s).**

male (58~85 kg)				female (47~72 kg)			
Front roundhouse kick		Back roundhouse kick		Front roundhouse kick		Back roundhouse kick	
90°	110°	90°	110°	90°	110°	90°	110°
9.5 ~14.00	10.90 ~14.65	11.50 ~16.50	13.15 ~17.55	9.50 ~12.35	10.80 ~13.95	11.70 ~13.80	13.25~ 15.9



**Figure 3 Velocity of male roundhouse kick leg.**



**Figure 4 Kick force of roundhouse kick leg.**

As to the differences of the kicking force in front and back roundhouse kick, we think it's due to the following several reasons: First, the back roundhouse kick being speedier than the front roundhouse kick mainly own to the involved hip muscular group can extend and shrink more greatly and work in a farther distance, it's profitable to finish the action in terms of time and space. Secondly: the attacking route of the whirling leg is adjusted according to the leaning state of the opponent's body. When the attacking leg is in front of the target at about the angle of 90°; its knee joint is sure to clasp inward and hip joints would turn inward more less accordingly. Thus it limits the situation of hip bending involved muscular group and influences the velocity of muscular shrink. Therefore, these lead to higher velocity of back roundhouse kick compared with front roundhouse kick. Third, there are two reasons which cause the difference in the linearity of the velocity curve. One reason is that athletes have different sports ability; another reason is that their technique, tactical styles and their individuality development are different. All the characteristic of the kick velocity showed the inner nature of the roundhouse kick, and they are the key points to help us to know and judge the kick velocity. Therefore, as to making training plan scientifically, instructing the practice correctly and applying technique and tactics, it has a far-reaching impact to understand the basic rules.

**CONCLUSION:**

1. Male and female athletes' kick force of front roundhouse kick is smaller than that of back kick. Kick force made while the suspended target was at the angle of  $90^{\circ}$  is smaller than at the angle of  $110^{\circ}$ .
2. Kick force of front and back roundhouse kick made while the suspended target was at the angle of  $90^{\circ}$  and  $110^{\circ}$  is related with weight division.
3. Kick velocity of front roundhouse kick for male and female athletes is slower than that of back kick. And kick velocity of front and back roundhouse kick while the suspended target was at the angle  $90^{\circ}$  is slower than that of at the angle of  $110^{\circ}$ .
4. Kick velocity of roundhouse kick is not related with weight division. But it depends on their physical and athletic quality.

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