The Effect of Target Height on the Trunk, Pelvis, and Thigh Kinematics in the Taekwondo Roundhouse Kick

Jae-Woong Kim, Je-Min Kim, Sang-Woo Lee, Ki-Hoon Han and Young-Hoo Kwon
Texas Woman's University, Denton, TX, USA
e-mail:kimjaewoong@twu.edu, web:www.twu.edu/kinesiology

INTRODUCTION

Three points are given for a head shot with the foot while up to two points for a body shot with the foot or fist according to the updated World Taekwondo Federation sparring rule (2009). The roundhouse kick is one of the most frequently used skills in Taekwondo sparring matches because of its usefulness in attack and counter-attack, short execution time, and high chance to score (Roh and Watkinson, 2002). It is crucial for an athlete to be able to use roundhouse kicks in response to various target heights.

The purpose of this study was to investigate the effects of the target height on the movements of the pivot hip, trunk, pelvis, and the kicking leg in the Taekwondo roundhouse kick.

METHODS

Nine male participants (black-belt holders) executed roundhouse kicks for two target heights (Body and Face). Their body weight, height, leg length, age, and level are respectively 76.2 ± 8.3 kg, 174.2 ± 5.9 cm, 82.7 ± 5.1 cm, 35.0 ± 4.8 years, and 4.0 ± 1.3 dan.

Body and Face heights are defined as each participant's abdomen level and chin level respectively with the same target distance in a sparring stance posture.

Each participant performed six successful roundhouse kicks (three/each condition). A double-handed mitt target was positioned for each participant's preference and tilted down and rotated slightly for a comfortable contact between the kicking instep and the target.

Linear displacements of the pivot hip and orientation angles of the pelvis, trunk, right thigh, and right shank were obtained through a three-dimensional video motion analysis (a 10-camera Vicon MX-T10 system) for motion capture and Kwon3D XP Motion Analysis studio for data analysis. The pivot hip displacements were normalized to the leg length (ankle-to-hip length) of each participant. The orientation angles were computed with mediolateral-anteroposterior-longitudianl rotation sequence from the two relative references: Pelvis to the Global Frame, Trunk to Pelvis, Thighs to Pelvis, and Shank to Thigh. Twenty five sphere reflective markers were placed on participant's body.

Displacements, peak orientation angles, and angle ranges were compared between the conditions using one-way repeated measures ANOVA ($p < .05$).

RESULTS AND DISCUSSION

During kick, the linear pivot hip displacement of Face showed significantly greater values than that of Body in Anterior-posterior and Longitudinal axes while less value in Medial-lateral axis (Table 1). Significantly greater orientation angles for Face were observed in the peak posterior tilted position, posterior tilt range, peak left-tilted position, left tilt range, peak left-rotated position, and left rotation range of pelvis, peak hyper-extended position of trunk, and the peak abducted position,

abduction range of hip joint, while for Body in trunk flexion range, peak internal-rotated position, internal rotation range of hip (Table 2). In other words, the orientation angles were significantly shown in the mediolateral, anteroposterior, and longitudianl of pelvis while only the mediolateral of trunk, and the anteroposterior and longitudianl of thigh. No significant difference was found in shank.

Among the displacements variables, anterior-posterior showed the greatest difference. It is considered that with the same horizontal target distance, it is to compensate the target distance for the Face compared to the Body since the kicking foot position for Face is vertically much further than Body from hip joint at impact.

The pelvis motion of posterior tilt, left rotation, and left tilt plays a main role in reaching the kicking thigh longer toward the target point. Increased left and posterior tilts of pelvis vertically raise the hip joint position of kicking leg, and increased left rotation adds the reach.

In terms of right thigh, the abducted position of the kicking thigh directly plays a main role to project to the target showing that Face and Body are 50.8° and 35.8° respectively.

SUMMARY AND CONCLUSIONS

It was to investigate the effects of the target height on the movements of body segments in the Taekwondo roundhouse kick. In order to kick to Face, athletes need to utilize the greater anterior-posterior hip displacement, pelvis left tilt, and hip abduction and internal rotation motion.

REFERENCES

Electronic reference formats recommended by the World Taekwondo Federation. (2009, June). Retrieved June, 2009, from http://www.wtf.org/wtf_eng/site/rules/competition.html

Roh, J. O., Watkinson, E. J. (2002). *Journal of Sports Medicine and Physical Fitness,* **42**, 348-353.

Table 1 Summary of Pivot Hip Motion Data from ST to IMP (N=9; in % Leg Length)

Variable	Target Height Condition		P
	Body	*Face*	
Medial-lateral	-4.2 ± 6.7	1.4 ± 6.6	0.0322
Anterior-posterior	37.4 ± 10.4	46.0 ± 9.4	0.0024
Longitudinal	12.1 ± 4.5	16.7 ± 4.5	0.0020

Table 2 Summary of the Pelvis, Trunk, Thigh, and Shank Motion Data (N=9; in degrees)

Orientation Angle	Variable	Target Height Condition		P
		Body	*Face*	
Pelvis	*Peak posterior-tilted position*	43.5 ±5.8	52.9 ± 7.7	0.0025
	Posterior tilt range	55.6 ± 6.3	65.2 ± 9.5	0.0033
	Peak left-tilted position	6.2 ± 4.3	16.9 ± 5.4	0.0000
	Left tilt range	11.2 ± 6.2	23.8 ± 9.0	0.0001
	Peak left-rotated position	64.4 ± 15.8	78.5 ± 14.9	0.0052
	Left rotation range	118.5 ± 26.4	134.8 ± 26.14	0.0048
Trunk to Pelvis	*Peak hyper-extended position*	18.9 ± 7.3	22.2 ± 7.0	0.0046
	Flexion range	15.7 ± 5.2	10.8 ± 7.1	0.0369
Hip	*Peak abducted position*	35.8 ± 9.0	50.8 ± 5.5	0.0003
	Abduction range	20.7 ± 9.5	36.2 ± 7.3	0.0007
	Position at peak internal rotation	(I)6.2 ± 10.2	(E)6.7 ± 10.2	0.0001
	Internal rotation range	33.1 ± 6.2	20.6 ± 8.5	0.0001

* I = Internal rotated position; E = External rotated position