

EXPERIMENTAL INVESTIGATION OF TURNING KICK PERFORMANCE OF SINGAPORE NATIONAL TAEKWONDO PLAYERS

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The purpose of this study is to describe and analyse the turning kick performance of some of the athletes in the Singapore National Taekwondo squad. A three-dimensional analysis was done using three Panasonic cameras (50fields/second). The raw data was processed using PEAK Motus and parameters of kick performance were presented. A comparison between players as well as players mentioned in other research papers was done to identify the variables that may contribute to kick performance. In Taekwondo, one other factor we looked into is the trajectory of the kick.

KEY WORDS: taekwondo, turning kick, singapore.

INTRODUCTION: There are a lot of techniques in Taekwondo. It was found that the turning kick is the most frequently used technique in Taekwondo (Lee, 1983). But yet, there seemed to be a lack of analysis in it. In this paper, we had chosen to describe and analyse the turning kick of some of the athletes in the Singapore National Taekwondo squad. There are a lot of factors that contribute to the final execution of the turning kick. Choi (1988) has proposed the theory of power. He has brought up the importance of applying science into training alongside with other types of training in order to maximise one's potential. i.e. the importance of the technique of executing a kick. Jake N. Pearson (1997) has done a detailed kinematics and kinetics report on the turning kick. He has identified the importance of sequential movement in affecting kick performance. The purpose of this report is to present some parameters relating to the kick, in this case, the maximum, minimum and average peak velocities and standard deviation and the time duration taken for the different phases. A comparison was done for the mean peak velocity between the athletes in the Singapore Taekwondo squad and with athletes as mentioned in papers by Conkel et al. (1988), Serina & Lieu (1991), Pieter & Pieter (1995) and Pearson (1997). This paper will also present the results of the trajectory of the kicks.

METHOD: Two male and two female athletes from the Singapore National Taekwondo squad took part in this study. Three Panasonic CP450 video cameras were used to capture the movements of the athletes at 50 fields/second. Pearson (1997) compared the differences of using 50 fields/second and 200 fields/second cameras for video capturing. It was found

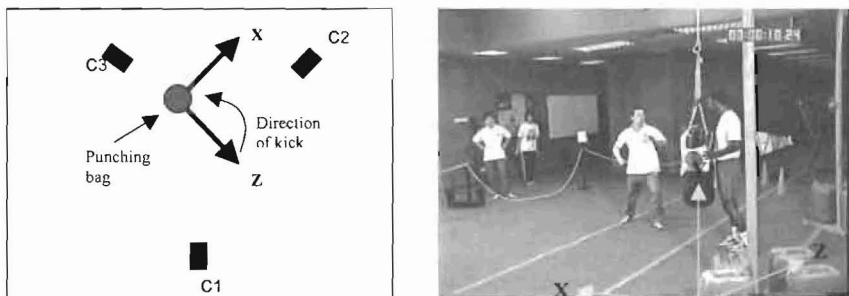


Figure 1. Layout of experiment and co-ordinates.

that the differences between the means of the two methods of data collection is 1.9% of the first mean, and thus deemed to be negligible. Therefore, the data was sampled at 50 fields/second here. Peak Motus v4.3 was used to process the data. The three-dimensional coordinates were reconstructed by the DLT method. The reconstructed coordinates were smoothed using the low-pass Butterworth filter at a cut-off frequency of 6Hz. The co-

ordinates system is located on the ground level (X-Z plane), the Y-axis of the system points upward and passes through the centre axis of the sandbag. Figure 1 shows the layout of experiment and location of co-ordinates system. The distance of the trajectory (distance of the path traced by the foot) is measured by taking the resultant of displacements in the X, Y and Z direction.

$$\text{Distance travelled in } 0.02s = [(S_x^{n+1} - S_x^n)^2 + (S_y^{n+1} - S_y^n)^2 + (S_z^{n+1} - S_z^n)^2]^{1/2}$$

where S_x^n is the magnitude of the x co-ordinate in frame n.

S_y^n is the magnitude of the y co-ordinate in frame n.

S_z^n is the magnitude of the z co-ordinate in frame n.

Velocity of foot is defined as the velocity of the toe. Duration of kick is defined as the time taken from the lifting of the heel from the ground to the maximum speed of the toe during the execution of the kick.

RESULTS AND DISCUSSION: The tables below show the different results of the kicks of Singapore National Taekwondo athletes. Peak speed is defined as the maximum speed reached for the whole execution of the kick and a 'fastest trial' is defined as the trial with the fastest peak speed.

Table 1. Max/Min/Average speed and standard deviation (n=5).

Subject	Peak speed (m/s)			
	Max speed	Min speed	Average Speed (n)	Std. Deviation
1 (male)	17.36	16.59	17.12	0.335
2 (male)	22.70	17.24	18.88	1.852
3 (female)	15.04	11.53	13.24	1.273
4 (female)	14.14	12.65	13.39	0.528

Table 2. Time duration of different phase of the fastest trial.

Subject	Lifting of heel max speed of hip (sec)	Max speed of hip max speed of knee (sec)	Max speed of knee max speed of foot (sec)	Total Duration (sec)
1 (male)	0.20	0.08	0.06	0.34
2 (male)	0.18	0.10	0.08	0.36
3 (female)	0.18	0.06	0.06	0.30
4 (female)	0.18	0.04	0.08	0.30

Table 3. Distance of trajectory.

	Distance of Trajectory (m)				
	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5
Subject 1	2.41*	2.31	2.30	2.36	2.29
Subject 2	3.04*	2.37	2.48	2.49	2.46
Subject 3	2.02	2.01	2.01	2.02*	2.00
Subject 4	2.06	2.05	2.20	2.15*	-

* The Fastest Trial

The fastest speeds of turning kicks obtained from this study are 22.70 m/s for male and 15.04 m/s for female. The mean peak velocities obtained are 18.0 m/s for male and 13.32 m/s for female. Table 4 shows a comparison of the mean peak speeds of the foot between the athletes from Singapore National Taekwondo squad and athletes from previous research (Conkel et al, 1988; Serina & Lieu, 1991; Pieter & Pieter, 1995; Pearson, 1997).

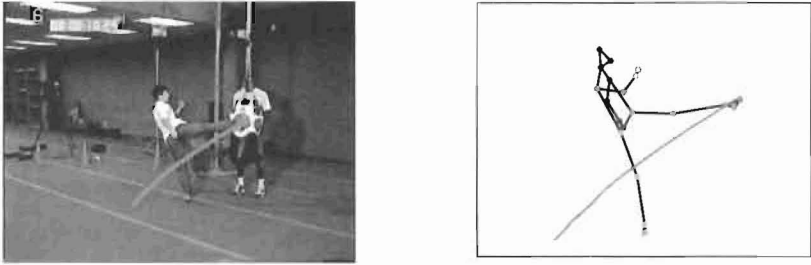


Figure 2. Trajectory of kick.

Table 4. A comparison of mean peak velocities of the foot during the turning kick.

Author/s (Year)	Type of subjects	Mean peak linear velocity of foot (m/s)
Conkel et al. (1988)	Elite males and females	14.6
Serina & Lieu (1991)	Male black-belts	15.9
Pieter & Pieter (1995)	Elite males	15.54
Pearson (1997)	Expert males	13.4
2002	Singapore National males	18.0
2002	Singapore National females	13.32

It is noted that the mean peak velocities of Singapore male Taekwondo athletes were significantly higher than the athletes mentioned in other research articles. (21.13% higher than the average of mean peak velocity the other athletes as mentioned in the reference papers.) The average durations of kicks are 0.35s (males) and 0.30s (females) respectively. As for the trajectories of the kicks, from the results, there seemed to be no relation between the shortest trajectories and the best trial (fastest peak velocity). However, it was noted that for the fastest trial of subject 2, the time duration taken from the maximum speed of the hip to the maximum speed of the knee is the longest among all 4 subjects, at 27.8% of the total time. While for the time taken for the other phases were quite the same, it was noted that generally, the longer duration taken for each phase, a higher resultant speed was produced. This may suggest that the time taken for each phase is significant in determining the resultant speed of the toe in the end. No data was given in past research papers regarding the time taken for each phase thus comparison with the other athletes were not possible.

CONCLUSION: Compared with the other subjects, the velocity of the turning kick from the subjects from Singapore National Taekwondo squad was significantly higher. This may be due to the different time duration taken for each phase during the kick. Comparison among the Singapore athletes has shown that longer time duration taken for each phase has resulted in a higher resultant velocity of the toe in the end. Some more studies can be done to further confirm this result. From the results, it was also noted that there seemed to be no relation between the trajectory of kick and the fastest resultant velocity of the kick.

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