

THE EFFECT OF KARATE STANCE ON ATTACK-TIME: PART II - REVERSE PUNCH

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This report presents the second part of an empirical study of the effect of stance on attack-time during a karate movement. A t-test and linear regression method are used to analyze the data collected from 24 elite karate competitors in simulated reverse punches. The results show the 7:3 stance exhibiting a slightly faster movement than that of the 5:5 stance. However, the mean difference is not significant. A two-way ANOVA is also adopted to analyze the data from Part I and Part II to identify the factors important to the attack-time. The results show the stance is the only factor significant to the attack-time. Since jab and reverse punch have their advantages in a contest. All the karate competitors should practice the two frontal-attack techniques in 7:3 stance to optimize the performance.

KEY WORDS: karate, reverse punch, stance.

INTRODUCTION: The frontal-attack using reverse punch is an important hand movement in karate training (Nakayama, 1986). Similar to the Part I (Liu and Wang) of this study, the reverse punch is also started with a fight-ready stance. The reverse punch is conducting the attack with the rear-positioned fist while rotating the trunk. With a proper stance and a smooth chained action of trunk, shoulder, arms, elbows, and hands, the resultant powerful impact force can deliver to the target in a short time (Gheluwe and Schandevil, 1983). In 1987, Yoshihuku et al. performed detailed motion analysis for several types of martial arts. They concluded an ideal speed as well as impact forces can be obtained by matching the motions of lower and upper extremities in a movement of jab or reverse punch. Comparing with the jab analyzed in Part I, the target hit by a reverse punch is usually at a lower position and the resultant force is usually larger than that of a jab. Since a proper stance for a powerful and stable reverse punch is a must in a frontal-attack. And for a frontal-attack in a karate match, the time to impact is the key to win a match. The purpose of this study was therefore to obtain quantitative information pertaining to attack-time during the movement of a reverse punch and to compare the results obtained in this section with the jab movement data in Part I.

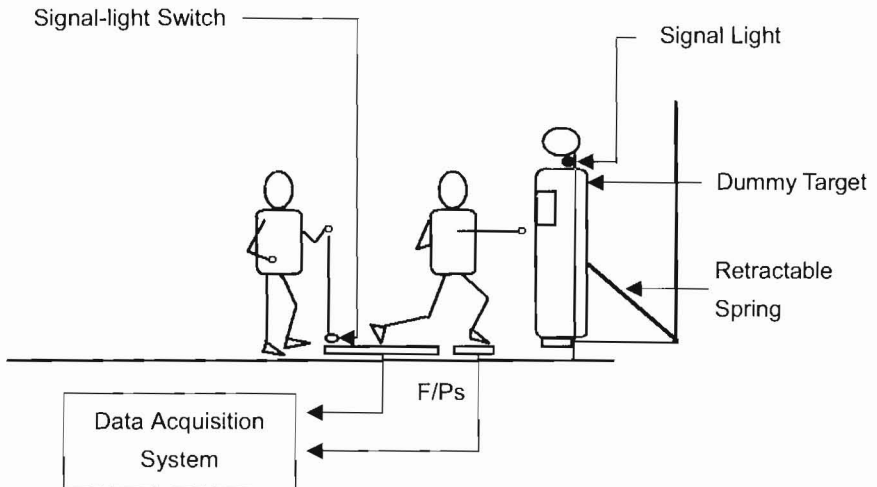


Figure 1. Schematic diagram of reverse punch tests on the two force plates.

METHODS: This report is the second part of a two-part report. The trials for reverse punch were conducted with the same 24 elite karate competitors and the performance was measured using the same apparatus as described in Part I. Figure 1 is a schematic diagram for a subject performing reverse punch on two force plates. A two-way ANOVA with randomized block factorial design is also adopted to analyzed the data from Part I and Part II to identify the factors (stance and combative technique) important to the attack-time.

RESULTS AND DISCUSSIONS: Figure 2 shows a stick figure of a reverse punch. The small circle in one of the hands denotes the attack-hand. As indicated in Part I of this study, the GRF and impulse generated by the rear-foot are the source of the body and attack-hand movement. Figures 3 and 4 show the impulse distributions for 7:3 and 5:5 stances respectively. Figures 5 and 6 display the maximum GRF distribution among the subjects for 7:3 and 5:5 stances respectively. It can be seen that all the impulse and GRF distributions are close to normally distributed. Figures 7 and 8 show the correlation between maximum GRF and attack-time for 7:3 and 5:5 stances respectively. Note that a poor data point (the attack-time is near 1.2 sec in Fig. 7) was observed in the 7:3 stance case which reduces the magnitude of the slope of fitted line. Figures 9 and 10 are the results of the regression analysis of impulse versus attack-time. In the linear regression analyses, the 5:5 stances for maximum GRF and impulse exhibit a higher correlation with a larger magnitude of slope than that of corresponding 7:3 stances. In addition, two-way ANOVA with randomized block factorial design is adopted to analyze the data from Part I and Part II. Table 2 summarizes the results from the ANOVA for attack-time difference subject to various stances and combative techniques. It can be seen that the difference due to stance effect to the attack-time means is significant at the 0.05 level. Nonetheless, the combative technique is statistically insignificant in the analysis.

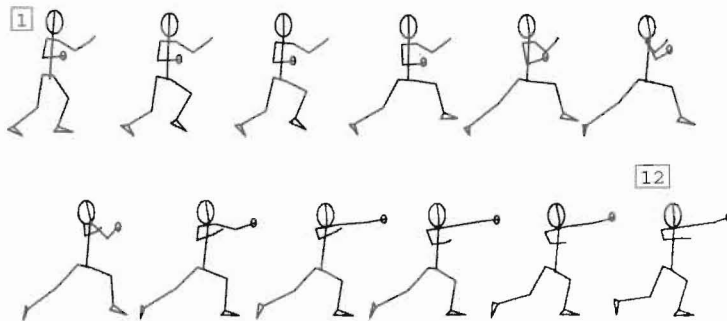


Figure 2. Stick figures of a reverse punch.

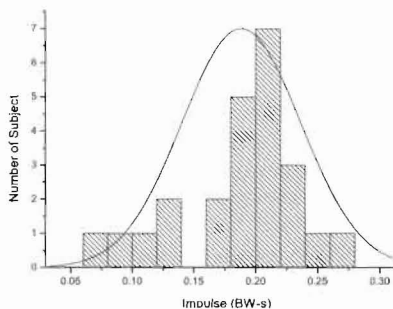


Figure 3. Impulse distribution of rear-foot in reverse punch movement (7:3 stance).

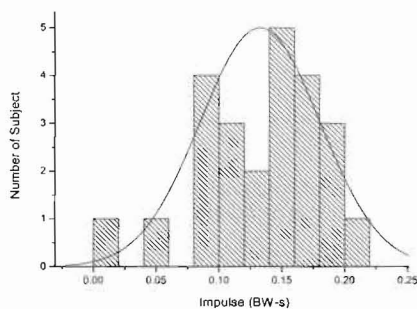


Figure 4. Impulse distribution of rear-foot in reverse punch movement (5:5 stance).

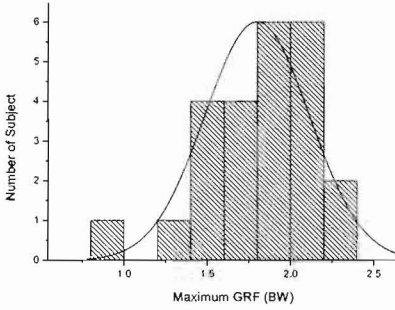


Figure 5. Maximum GRF distribution of rear-foot in reverse punch movement (7:3 stance).

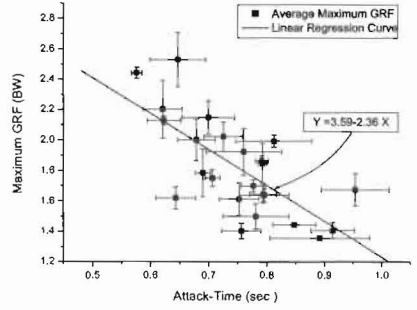


Figure 8. Linear regression analysis of maximum GRF versus time in 5:5 stance.

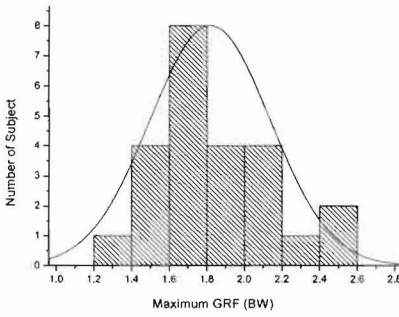


Figure 6. Maximum GRF distribution of rear-foot in reverse punch movement (5:5 stance).

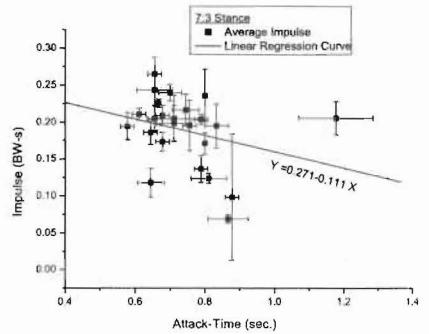


Figure 9. Linear regression analysis of impulse versus time in 7:3 stance.

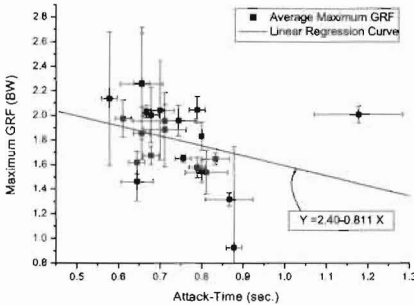


Figure 7. Linear regression analysis of maximum GRF versus time in 7:3 stance.

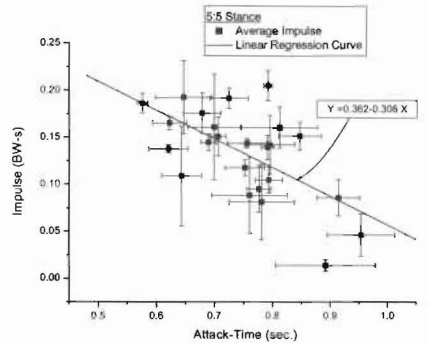


Figure 10. Linear regression analysis of impulse versus time in 5:5 stance.

Table 1. Two-sample paired t-test for attack-time difference subject to various stances.

Sample	Number of Samples	Mean±SD	t Value	d.o.f.	P Value
7:3 Stance	24	0.743±0.124	-0.427	23	0.673
5:5 Stance	24	0.751±0.096			

Table 2. Two-way ANOVA with randomized block factorial design for attack-time difference subject to various stances and combative techniques.

Source	Sum of Squares	d.o.f.	Mean Square	F Value	P Value
Stance (a)	0.020	1	0.020	5.164	0.033
Combative Technique (b)	0.0019	1	0.0019	.380	0.544
Interaction (a*b)	0.043	1	0.043	4.708	0.041
a*b Error	0.210	23	0.0091		

CONCLUSIONS: This report presents the second part of an empirical study of the effect of stance on attack-time during the movement of a reverse punch in a simulated karate contest. The results show the 7:3 stance exhibiting a slightly faster movement than that of the 5:5 stance. However, the mean difference is not significant. The result of two-way ANOVA indicates the stance is the only factor significant to the attack-time when considering the data collected in Part I and Part II. Also note that the punch force is usually larger in a reverse punch than that of a jab due to the increased impulse in a trunk rotation. And the target is usually at lower position when a reverse punch is adopted. Since both the two frontal-attack techniques have their advantages in a contest. And the attack-time determines the performance in a frontal attack in a karate tournament. All the karate competitors should practice jab and reverse punch in 7:3 stance with the aid of a force plate to collect the GRF and impulse of rear-foot. The measurement of impact force and hand speed due to the punches in various stances may also provide useful information in understanding the kinematics of a frontal attack, which deserves a further study.

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