GROUND REACTON FORCE OF TABLE TENNIS PLAYERS WHEN USING FOREHAND ATTACK AND LOOP DRIVE TECHNIQUE

Dong Yuqiang [1] Zhang Xiaodong[2] and Xiao Dandan[3]

Yanshan University, Qinhuangdao, Hebei, China[1] North China Electric Power University, Beijing, China[2] China Institute of Sport Science, Beijing, China[3]

The subjects were 10 excellent ping-pong players in China. The table tennis techniques of the forehand attack and forehand loop drive were tested, using the measurement methods of the KISTLER force-plate system. The results showed that the biggest GRF of the attack technique in vertical direction was higher than the loop drive technique, and the biggest GRF of the attack technique in left-right direction and the fore-aft direction were mostly lower than the loop drive technique.

KEY WORDS: GRF; vertical direction; medial-lateral direction; anterior-posterior direction; biomechanics; dynamics

INTRODUCTION: Table tennis forehand attack technique and forehand loop drive technique were the main attack technique in table tennis. The data of external force like GRF can show us the kinetic strategies of lower limbs (Yu-Yuan Chen, Yi-Chang Hsueh, et al.,2012). Using the GRF and EMG to study the lower-limb activity during the power serve in tennis(Olivier Girard,Jean-Paul Micallef, et al.,2005) to understand the lower limbs' force in table tennis, the study on the characteristics of Ground Reaction force(GRF)of athletes in action technique was helpful. The GRF of table tennis plays during the forehand loop technique were studied to explain how the player' lower limbs forced when driving the ball with the biggest force (Xiao Dandan, Su Piren,et al, 2008). The purpose of the study was aimed to reveal the characteristics of GRF in two table tennis techniques and to find out the GRF differences between two techniques by the use of KISTLER three-dimensional measuring and testing system.

METHODS: The subjects were 10 elite table tennis players (right-handed) in the Beijing Sport University. GRF in two kinds of table tennis techniques were tested by the KISTLER 3-D force platform system. The data acquisition frequency of force platform system was 1000 HZ. "Time of the data acquisition was 5 s. each trial. The force platform system was zero cleared, aimed to eliminate the influence of athletes' different weights on the experimental results, when the athletes stood in a well-balanced posture on the force platform and prepared for the test. The subjects were required to complete the forehand attack and forehand loop technique naturally, hit the ball with the biggest strength, and promise the two feet standing on the centre of each force platform. The testing of each action was not stopped until the high technical quality data for one technique were acquired at least three times. Statistical method was the Wilcoxon's non-parametric test.

RESULTS AND DISCUSSION: GRF IN THE VERTICAL DIRECTION: With the Wilcoxon's non-parametric test, the peak GRF value in the forehand attack technique was bigger than that of the loop drive technique. The peak GRF value of left and right foot in attack technique was 303.4 ± 33.3 N and 272.4 ± 21.2N. The peak GRF value of left and right foot in loop drive technique was 208.0 ± 27.2 N and 226.7 ± 19.6 N (table 1). The difference was significant. The result suggested that the body centre of gravity in the forehand attack technique was moved to contra lateral foot more, compared with the forehand loop drive technique.

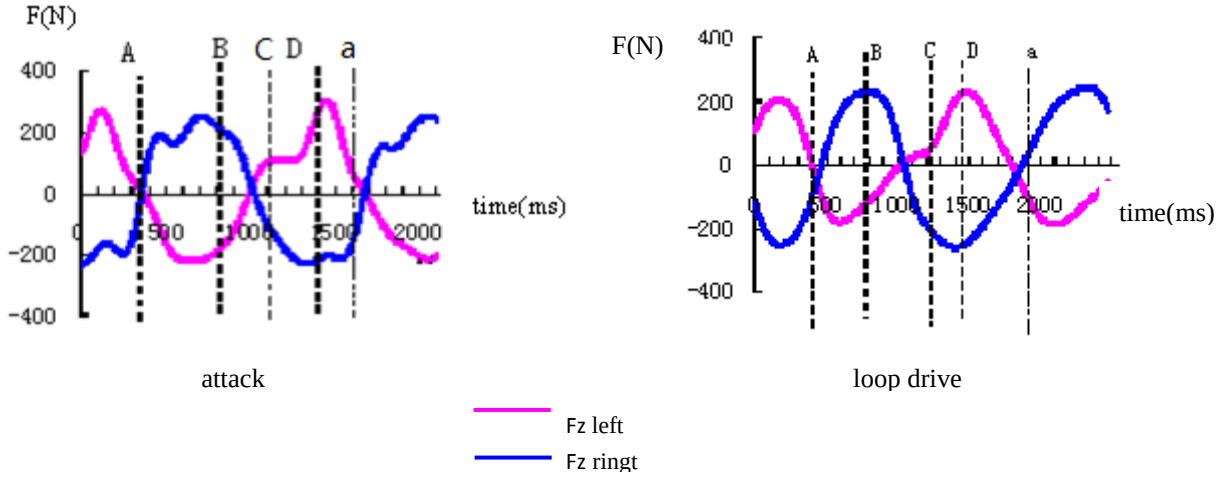

Figure1 GRF of two feet in vertical direction

Note：（1）Fz left mean the GRF on the left foot in vertical direction, Fz right foot mean the GRF on the right foot in vertical direction. Positive value was higher than weight line, and the negative value was lower than the weight line. 0 line was the weight line.

(2) A point was the restore moment. B point was the end moment of swinging the racket backward. C point was the moment of hitting ball. D point was the end moment of swinging the racket forward. And a point was the next restore moment.

(3) A—B was the phase of swinging racket backward. B－C was the phase of swinging and hitting ball. C—D was the phase of swinging racket forward；D—a was the phase of returning to the original condition.

(4)The curves were representative curves, which were the display of a representative player. (the follows were the same).

Table 1 The peak value of vertical GRF in two techniques（n=10） unit：N

	attack （M±SD）	Drive （M±SD）
Peak value of right foot	272.4±21.2*	226.7±19.6
Peak value of left foot	303.4±33.3*	208.0±27.2

*means p<0.05，there was significant difference between forehand attacking and loop drive technique. (the follows were the same)

GRF IN THE MEDIAL-LATERAL DIRECTION: Seen from Figure 2 and table 2, the maximum value of right foot GRF in right direction in forehand loop drive technique (63.8 ± 7.6N) was higher than that in attack technique (40.5 ± 2.5N). The maximum value of right foot GRF in left direction in forehand loop drive technique （41.8±3.6N） was higher than that in attack

technique（16.2±2.6N）. The maximum value of right foot GRF in right and left direction in forehand loop drive technique （41.5±5.7N、63.6±7.2N） were higher than that in attack technique（ 9.4±2.4N 、 35.0±5.3N ）respectively. The differences were significant. This suggested that we should pay more attention to the force of thrusting against the ground during the completion of forehand loop drive technique.

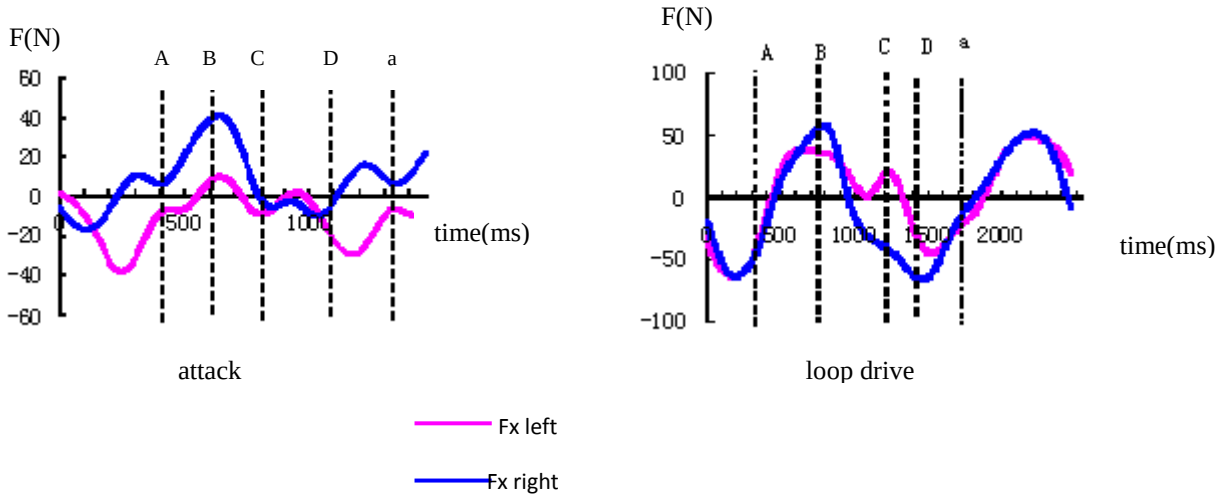

Figure 2 GRF in the medial-lateral direction

Note：Fx left mean the GRF on the left foot in medial-lateral direction, Fx right foot mean the GRF on the right foot in horizontal direction. Positive value was the right direction.

Table 2 The peak and valley value of medial-lateral GRF in two techniques（n=10） unit：N

	attack（M±SD）	drive（M±SD）
peak value of right foot	40.5±2.5*	63.8±7.6
peak value of left foot	9.4±2.4*	41.5±5.7
valley value of right foot	－16.2±2.6*	－41.8±3.6
valley value of left foot	－35.0±5.3*	－63.6±7.2

GRF IN THE ANTERIOR-POSTERIOR DIRECTION: Compared the peak and valley value of GRF in anterior-posterior direction, there were significant differences between the two kinds of technical action. The maximum of forward GRF on the right foot of the forehand attack (36.9 ± 3.0 N) was less than that of the loop drive (59.9 ± 7.0N). This suggested that the center of gravity in loop drive technique moved backward more fully, compared with the attack technique, during the process of swinging racket backward.

Table 3 The peak and valley value of GRF in anterior-posterior direction（n=10） unit：N

	attack（M±SD）	drive（M±SD）
peak value of right foot	36.9±3.0*	59.9±7.0
valley value of left foot	－51.4±6.8*	－61.1±4.8
valley value of right foot	－52.9±5.2*	－63.5±7.9
peak value of left foot	52.4±8.0*	23.1±2.5

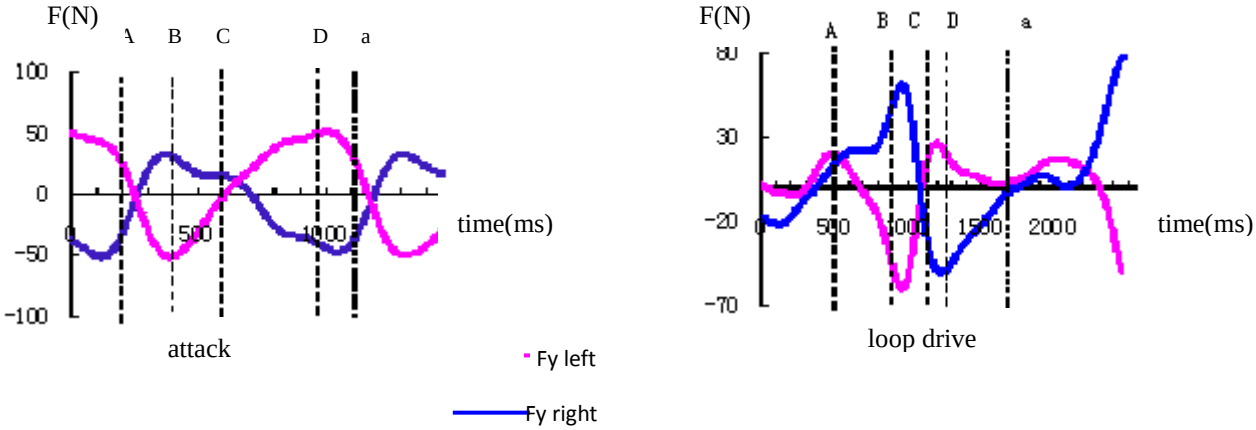

Figure 3 GRF in the anterior-posterior direction

Note：Fy left mean the GRF on the left foot in anterior-posterior direction, Fy right foot mean the GRF on the right foot in anterior-posterior direction. Positive value was the backward direction.

CONCLUSION: There were differences in some biomechanical indexes between the forehand attack and loop drive technique. The maximum GRF of the attack technique was bigger than that of the loop drive technique in vertical direction. The maximum GRF of the loop drive technique was bigger than that of the attack technique in the horizontal and anterior-posterior direction. This suggested that the forehand attack technique should be paid more attention to push off the ground downward, and the forehand drive technique should be paid more attention to push off the ground in the medial-lateral and anterior-posterior directions.

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