



Original Article

The comparison of dominant and non-dominant hand velocity during Gyakuzuki technique in elite Karatekas.

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Abstract

Background: The purpose of this research was to compare the velocity of the dominant hand and the non-dominant hand in the Gyakozuki technique (with hit and without hit) of elite karate men.

Methods: 16 Iranian male karatekas with individual characteristics from the national karate team camp participated in this study. The subjects were asked to perform the Gyakuzuki technique with the dominant hand and the non-dominant hand five times with maximum intensity and strength, hit the shoot fist device. The distance of standing from the device was equal to the length of the upper limb, and the best record of all five performances was considered. It was recorded using a Hero3 digital camera made in the United States (240Hz) in two dimensions. It was filmed at a perpendicular angle to the subject. The peak velocity of the joints (shoulder, elbow, wrist) and the velocity at the moment of the collision were evaluated using Skillspector software. After ensuring the normality of the data using the Shapiro–Wilk test, independent t-tests were used at the level of ($p \leq 0.05$) with spss version 22 software.

Result: The test results showed a significant difference between peak joint velocity shoulder, elbow, and wrist with the dominant and non-dominant hand in the with-hit and without-hit method ($p \leq 0.05$). Also, there was a significant relationship between the velocity of the wrist in contact moment with the dominant and non-dominant hand in the with-hit and without-hit methods ($p \leq 0.05$).

Conclusion: According to the test result, if a karate man wants to reach to velocity peak with the dominant hand in Gyakuzuki Techniques, he should reinforce the antagonist and stabilizer muscles in the non-dominant hand.

Keywords: Karate, Gyaku Zuki, velocity

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Introduction

Karate is one of the martial arts, which means hand-to-hand combat that includes quick hand and foot strikes (1). This sport has a history of five thousand years and was able to become an Olympic sport. In recent years, Iranian karate has been considered one of the active and medal-winning disciplines at the international level, which even received an Olympic quota. Among the hand skills of karate, we can mention the Gyakozuki skill of directly punching the opponent's body with the opposite hand of the guard (which is the first and simplest hand skill in Kumite fighting (2, 3). The Gyakuzuki technique is considered a throwing skill and movement pattern. Its kick is also a throw that in Kumite competitions, Kumite athletes, by evaluating the appropriate distance with the opponent, will hit the opponent with full speed and power control(4).

In throwing and kicking skills that are performed at high speed, there is a rapid acceleration of the body parts of the athlete (4) and the acceleration starts with those parts that are in contact with the ground (5). This whip-like sequence goes upwards from the legs to the thigh, from the thigh to the chest, and finally ends with a high-speed kick or throw. Gyakuzuki technique in karate is considered among throwing skills, and therefore its movement pattern is also throwing (6). Research has shown that the principle of the synthetic chain is used in activities where the distal components are free at the end of the chain (3, 7). An example of the kinetic chain is Gyakuzuki's technique in karate, where first the hip, then the spine, chest muscles, shoulder, and finally the forearm and hand are involved, respectively, by calculating the speed of the joints (shoulder, elbow, and wrist). A different time for the peak velocity of the joints, which occurs in different percentages in the total movement time, has been observed (4, 8). The result obtained from all the studies was to reach the peak speed in the sequence of movement of the joints with correct timing (4, 9).

In other words, the proximal part reaches its peak speed earlier than the distal part. On the other hand, in karate, the speed of skill execution is one of the main factors(2). Speed is an important factor in gaining power (10). The type of movement required in karate is not to move a heavy object slowly, but to move a light object at maximum speed(11). In the execution of the kick, if only the power of the hands and feet is used, the technique will be very weak((12, 13). To reach the maximum force, it is appropriate to use the force of all body parts in time sequences, and the force obtained from Gyakozuki's technique according to Newton's second law is highly dependent on the amount of mass involved and the

accelerations obtained by the upper limbs, trunk, and limb, bs. It will have the bottom that in the shoot fist device, these speed changes (acceleration) are well taken into account to reach the peak velocity at the end of the route (14). In the hitting method, because posited muscles and stabilizing muscles (biceps, Rhomboid major, trapezius) are not involved until the last moment of execution, karateka can reach peak execution speed.

Among the karate skills, Gyakozuki is one of the major and main skills that is used in most kata (execution of form) and also in Kumite (combat) competitions (4). According to the statistics obtained in the world championships in 1992 Spain, 2004 Cyprus, 2006 Finland, 2008 Japan, 2010 Serbia, 2012 France, 2014 Germany, and 2016 Austria, most of the points obtained were from Giyakuzuki's skill (15). Milliseconds and thousandths of a second play an important role in winning sports medals, performing the Giyakuzuki skill at a higher speed is of particular importance for Kumite athletes (16). The goal of the Gyakuzuki technique in karate is to hit the opponent at a controlled distance in the least possible time. Hofmann (2008) concluded that the main reason for using punches instead of feet in these fights is that punching doesn't need much time and the movement is less complicated than kicking. Therefore, to be better than the opponent and receive points from the referee, karatekas try to reduce the total movement time in the technique used (7). On the other hand, committee athletes rarely get the necessary points by changing the guard and performing the technique with the non-dominant hand. Considering the importance of Gyakuzuki skill in karate, in the present research, we tried to compare the speed of the dominant hand and non-dominant hand in Gyakuzuki technique (with hit and without ahit) of elite karate men to improve the execution of the technique and the correct time of use in special situations and safe implementation should be taken into consideration.

Material and methods

The current research is descriptive-comparative. The purpose of this research was to compare the speed of the dominant hand and the non-dominant hand in the Gyakozuki technique (with hit and without ahit) of elite karate men. 16 Iranian male karatekas with individual characteristics (age: 24 ± 1.4 years, weight: 73 ± 6.6 kg, height: 176 ± 2.4 cm) all in the national karate team camp participated in this study. Before the test, the body was warmed up for 10 minutes. The subjects were asked to perform the Gyakuzuki technique with the dominant hand and the non-dominant hand five times with maximum intensity and strength; hit the shoot fist device. The distance of standing from the device was equal to the length of the upper limb, and the best record of all five performances was

considered. It was recorded using a Hero3 digital camera made in the United States (240Hz) in two dimensions. It was filmed at a perpendicular angle to the subject. The peak velocity of the joints (shoulder, elbow, wrist) and the velocity at the moment of the collision were evaluated using Skillspector software. After ensuring the normality of the data using the Shapiro–Wilk test, independent t-tests were used at the level of ($p \leq 0.05$) with spss version 22 software.

Results

Descriptive statistical results of the measured variables of the peak velocity of the joints shoulder, elbow, and wrist with the dominant and non-dominant hand in two methods with and without impact, the velocity of the wrist joint at the moment of impact) with the dominant and non-dominant hand to the mean \pm standard deviation are presented in Table1.

Table 1. Descriptive statistics values of subjects with the dominant hand and non-dominant hand in two methods with hitting and without hitting (n=16)

Variable	dominant hand		non-dominant hand	
	with hit	without hit	with hit	without hit
	Mean \pm SD	Mean \pm SD	Mean \pm SD	Mean \pm SD
Shoulder joint peak velocity(m/s)	5.6 \pm 0.39	4.7 \pm 0.18	3.73 \pm 0.22	2.5 \pm 0.11
Peak velocity of the elbow joint(m/s)	10.1 \pm 1.42	7.86 \pm 0.83	7.5 \pm 1.27	4.8 \pm 0.57
peak velocity of the wrist joint(m/s)	11.4 \pm 1.50	9.5 \pm 0.80	9.4 \pm 1.5	7.5 \pm 0.80
thevelocity of the wrist joint at the moment of impact(m/s)	5.15 \pm 0.95	-----	3.34 \pm 0.72	-----

The results of the independent t-test showed that there is a significant difference between the dominant hand and the non-dominant hand in the peak velocity of the shoulder, elbow, and wrist joints in the implementation of the Gyakuzuki technique in the hit and non-hit method ($p < 0.05$). Also, there is a significant difference between the dominant hand and the non-dominant hand in the velocity of the wrist joint at the moment of impact ($p < 0.05$) (Table 2).

Table 2. Independent t-test results

Variable	two methods	Calculated	
		t-test independent value	p
Shoulder joint peak velocity	with hit	1.34	0.001*
	without hit	1.11	0.001*
Peak velocity of the elbow joint	with hit	1.55	0.001*
	without hit	1.20	0.001*
peak velocity of the wrist joint	with hit	1.94	0.001*
	without hit	1.42	0.001*
the velocity of the wrist joint at the moment of impact(m/s)	with hit	0.45	0.001*

*. P ≤ 0/05

Discussion

Since in karate fights, the speed of techniques plays a significant role in the success of karatekas, in the field of biomechanical research, it is necessary to pay attention to issues related to speed (17), So far, much research has been done in the field of karate in analyzing the techniques or the performance of karatekas, but no research was found to check the superior hand with the non-superior hand in two methods with and without hitting (15). Since kata means fighting with an imaginary opponent, it is also important to conduct research without hitting, considering the importance of the subject in this research, to compare the peak speed of the Gyagozuki technique, the speed of the wrist at the moment of contact between the upper hand and the hand. It is non-superior in two methods, with and without hits, and the results of the research are as follows:

The results of the present research show that the peak velocity obtained in the joints (shoulder, elbow, wrist) with the dominant hand compared to the non-dominant hand had higher values in the two methods with and without impact. Also, according to the observed time delay of the joints (wrist, elbow, and shoulder) with the dominant hand and the non-dominant hand in two methods with hitting and without hitting, it shows that Gyakuzuki

follows the traditional chain despite the high speed of its execution. The results of this research were reviewed with other research for and against.

The research findings of Gabriela et al. (2011) support the results of the current research and show that Gyakozuki's technique follows the traditional chain model. In other words, in this research, the proximal limb reaches the peak speed earlier than the distal limb, and the findings of this research are also consistent with the current research. Also, the peak speed of the current research was compared with positive and negative research in this field. Antonio et al.'s (2011) research showed that in the Gyakozuki kick, the opening of the elbow joint is done immediately after the acceleration of the shoulder joint (19). The findings of this research are also consistent with the current research. Also, the results of Anino's (2010) research showed that the peak velocity of the wrist joint in the Gyakozuki strike is 13 m/s (3), and the findings of this research are also consistent with the findings of the current research regarding the peak velocity of the wrist joint. The results of the study by Feldo et al. (1979) showed that the hand reaches the maximum speed in the karate punch a little before fully opening. The range of wrist velocities was between 10 and 14 meters per second (4) and the findings of this research are also consistent with the current research. Chiadez (1966) found that reducing the speed of elbow opening just before hitting the target is necessary to strengthen body joints and increase body mass. The maximum value of Gyakozuki's velocity in the wrist joint was 7.18 to 9.62 m/s when hitting the technique, and the findings of this research are also in line with the current research (4). But the result of Suwarganda et al.'s (2009) research showed that the values obtained in the peak velocity in the joints (shoulder, elbow, wrist) in male subjects are equal to 4.61, 7.36 and 7.65 m/s, respectively(12). But the findings of this research, because Makiwara was hit, probably the karatekas have slowed down their performance due to damage to the joints, and it is inconsistent with the current research. Also, Hofman (2008) concluded in his study that the Gyakozuki technique in the first subject had a shoulder joint peak velocity of 2.9 m/s and a wrist joint peak speed of 8.4 m/s, the second subject had a shoulder joint peak velocity of 3.4 m/s and the peak velocity of the wrist joint is 1.8 m/s, the third subject's peak velocity of the shoulder joint is 1.3 m/s peak velocity of the wrist joint is 3.8 2 m/s (7). The findings of this research are also inconsistent with the obtained values due to the number of samples in the current research. Vos and Binkhorst (1966) also concluded that the production of high velocities in the striking body is very important in impact situations and reported wrist

velocity between 12.5 m/s and 14.2 m/s for three skilled karatekas. The results of this research are consistent with the current research (20), but the number of subjects is not consistent with the current research. The results of the research showed that there is a significant difference in the speed of the wrist joint at the moment of impact between the dominant hand and the non-dominant hand. In other words, the speed of the wrist joint at the moment of contact with the dominant hand is higher than that of the non-dominant hand. The results of the wrist speed at the moment of collision in this research were examined with other research. Nakayama's (1989) research shows that the fist should hit the target with maximum power. He points out that all the muscles involved in making a reverse punch must work with each other and strike with power at the moment of impact (21). Also, Okazaki's (1984) research refers to the principles of force in karate, which is affected by five factors (magnitude, direction, speed, range of motion, stability, and stability) during collision and changes, the force will be greater. If the object's mass or speed increases, the amount of movement will also increase, and the greater the amount of movement, the greater the force applied to the target. Therefore, it can be concluded that the higher the collision speed, the greater the force on the opponent (22). In another study, Grabiner (1982) concluded that movement speed is one of the most important factors in martial arts. He reported that higher speeds enable karateka to have more mechanical energy to strike (23). The findings of this research are also in line with the current research. Also, in a study by Feldo et al. (1979), skilled karatekas focus their punches right inside the target, so that the punch reaches a maximum speed at the moment of impact and has a greater amount of movement in the target (24). The findings of this research are also in line with the current research. In the research of Chiadez (1966), the value of hand velocity when hitting 5.93 m/s to 8.30 m/s was obtained (4), and the findings of this research are also in line with the present research. Therefore, according to the test result, if a karate man wants to reach to velocity peak with the dominant hand in Gyakuzuki Techniques, he should reinforce the antagonist and stabilizer muscles in the non-dominant hand.

Conclusion

In martial arts, strikes at maximum speed, from effective movement the opponent prevents, and in general, the speed of execution of techniques and tactics in karate fights at the professional level is very effective and considered an important step in the success of

their fights. From the sum of the research conducted in this regard, it can be concluded that about the difference in speeds achieved in the state with and without being hit, there is a possibility that the person in the state of being hit has less need for opposing muscles and has stabilizing muscles (biceps, Rhomboid major, trapezius) of body joints; Because the impact device itself can be used as a wrist speed reducer in the shortest possible time. Therefore, the peak velocity in the effective method is higher than in the non-effective method. On the other hand, considering that the speed of the technique with the dominant hand in both methods is higher than the non-dominant hand, therefore, for the karateka to achieve higher speeds with the non-dominant hand in performing the Gyakuzuki technique, the opposing muscles and strengthen the stabilizers of the non-dominant hand are important.

Declarations

Compliance with ethical guidelines

To observe the ethical principles in the tests, the present research proposal was reviewed and accepted by the Research Institute of Motor Sciences (ethics ID: IR-KHU.KRC.A-1000-A)

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Conflicts of interest

The authors declared no conflict of interest.

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