KINEMATIC-KINETIC COMPARISONS OF TSUKI TECHNIQUE IN PERFORMING FROM WAIST AND FROM MIDWAY IN CLASSIC AND INDIVIDUAL STYLES

M.M. Shahbazi[1], M. Sheikh[2] and A. Amini[3]
[1]Physics Department of Tehran University and Edinburgh University, UK
[2]Physical Education Faculty of Tehran University, Iran
[3]Physical Education Department of Amirkabir University, Iran

The aim of this study was to quantify the difference between two different karate performances in Tsuki techniques from waist and from midway, in classic and individual styles. Eleven female karateka, with different levels of training and knowledge of karate were volunteered to our study and filmed with two cameras at 250 Hz. This allowed the two dimensional reconstruction of the movements of selected body landmarks. Five landmarks (shoulder, elbow, wrist, upper-right and upper-left fist) were analyzed, while performing Tsuki. For each karateka and punch, the average time of execution was calculated and the standard deviation of each of two special coordinates X and Y were computed for each landmark. A total standard deviation of the single karateka and punch was also calculated. Through the analyzing we achieved the kinematic and kinetic parameters of each karateka. By the comparison of the different styles and performances, remarkable results have been achieved.

KEY WORDS: comparison, Tsuki technique, classic, individual styles, waist, Midway

INTRODUCTION: From the beginning of time, the body has been used to kick, punch, butt, throw, hold down, choke, and assert other movements for self protection, exploitation against others, and/or development of physical skills, and self-discipline for personal well-being Battle, 1992; Yang, 1999. The underlying premise of modern karate maintains that, when needed, the hands may be used as weapons; various body parts may take on a degree of specificity. Americans have long recognized the usefulness of engaging their hands as weapons. As natural weapons hands have been employed to punch in different ways, such as; back fist and fore fist strikes or jabs, hook punch, reverse punch, and Tsuki. However, it was not until the introduction of karate in the early 1950's that hands earned the reputation of potential deadly weapons.

One of the most distinguishing characteristics of Tsuki is the speed, accuracy and effectiveness. Many practitioners may execute Tsuki in their individual style, while many others may execute in classic style (Berry, 1991). The question is which of the following executions in Tsuki; from waist or from midway is more accurate, effective and powerful? The answer may seem really fairly simple and quite well thought out. The exact answer may come out from a dynamic examination.

The proper executed Tsuki punch is normally launched from the side keeping the fist vertical, but the fist will be twisted at the end of execution (Zambo, 1993). The elbow is kept close to the side and the solar plexus, not higher at the face or head.

Many investigators believe that keeping the fist vertical the entire time, may transfer more power, comparing with the twisted fist. They think that the speed in vertical fist is higher than the twisted fist, while the mass is the same. In this study, all the subjects twisted the fist at the end of execution.

The present study, considers the Gyaku-zuki technique in different performances (classic and individual styles from waist and from midway) in order to justify and offer a more effective, accurate and powerful method.

METHODS: Eleven skilled females karateka with average mass of 59.9 ± 5.4 kg, average age of 24 ± 5 years and average experience of 6.5 ± 2.5 years volunteered to participate in this study. As the aim of the present work was to study the Tsuki performances in two styles; e.g., classic and individual and in each style two executions; from waist and from midway, Fig.1, therefore all subjects were to execute four executions. Two cameras were located at

about 7 meters from the side and at about 4 meters in front of the subjects. The taped data were played back to the subjects in order that they execute their performances more correctly. We have chosen their best performances. The data were then analyzed with Win-Analyze program.

RESULTS AND DISCUSSIONS: The results of this study offer clear support for the first of the stated hypotheses that throw from midway would be superior to throw from waist. They also provide further support for White and Hardy's finding that Tsuki performances would have special importance in combat and the faster the throw is the more effective would be the throw. It is worth noting here that although the participants were skilled karatists, they were relatively unwilling to perform Tsuki performance from midway.

It is possible that performance from midway enhances the speed of the act but perhaps does not enhance the achievement. Consequently, it would not be as useful at a later stage of learning, when performances have already acquired a clear habitude of the act. Further support for this argument was obtained through anecdotal evidence from the karate instructor who taught the kata used in the present study.

In Table 1, force, energy, and power of arm and forearm of subjects along with the linear and angular velocities and acceleration of wrist are shown. As we can notice the mean energy in classical performance and from waist is greater than the energy from midway. This is because the distance from waist is longer than the distance from midway and therefore greater speed can be achieved. In contrast with the energy, the power generated in throw from waist is less than the power from midway; this is because of the shorter time, which is taken in throw from midway.

The applied force depended upon the distance as well as the body inertia of the performer. But in non-classic performance, the force is greater than in classic throw and the longer the distance is, the greater would be the force. The angular velocity of the wrist is mainly dependant upon the correct performance and also on the distance of the displacement. In Figure 1, the techniques (from waist and from midway) are shown by a selected subject and in Figure 2, the speed of wrist of this selected subject in different techniques are shown.

Table 1 Kinematic and dynamic parameters values in different techniques.

Technique	Force (N)	Energy (Joules)	Power (Watts)	Linear Sp. (m/s)	Ang. Sp. rad/s	Acceler. rad/s.s
Classic and from Waist:						
Arm	802.7 ± 24	1711 ± 37	7791 ± 58			
Forearm	780.8 ± 37	1503 ± 54	6730 ± 54			
Wrist				16.2 ± 2.3	15.3 ± 1.2	2.18 ± 0.43
Classic and from Mid-way:						
Arm	776.2 ± 24	1180 ± 37	8778 ± 58			
Forearm	640 ± 37	1304 ± 29	7713 ± 54			
Wrist				13.7 ± 2.3	13.7 ± 1.2	2.3 ± 0.33
Non-Classic and from Waist:						
Arm	927.6 ± 24	1885 ± 37	7296 ± 58			
Forearm	687.6 ± 37	1821 ± 29	6038 ± 54			
Wrist				12.2 ± 2.3	14.4 ± 1.2	2.13 ± 0.3
Non-Classic and from Mid-way:						
Arm	716.2 ± 24	1897 ± 37	7830 ± 58			
Forearm	677.37 ± 37	1452 ± 29	6422 ± 54			
Wrist				10.2 ± 2.3	12.32 ± 1.2	2.3 ± 0.3

Figure 1 Performance of Tsuki from waist (left) and from midway (right).

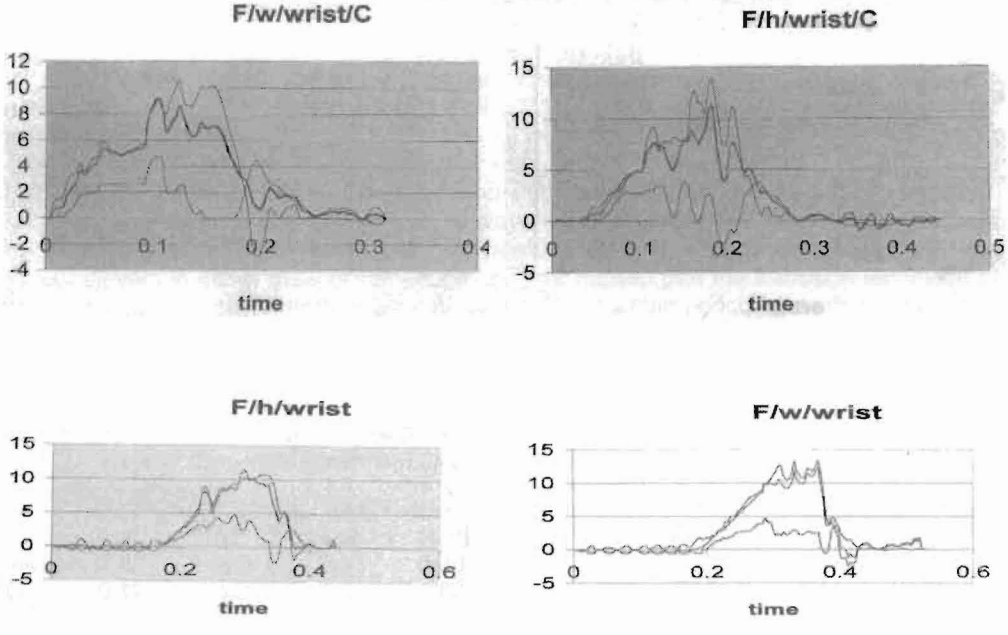

Figure 2 The speed of wrist of selected subject in different techniques for comparison.

CONCLUSION: Results of this study suggested some meaningful implications for those who are engaged in the teaching or helping professions, and for the body of knowledge in marshal arts. Since the research was experimental in nature, and established on a sound scientific basis, it offered an alternative reference point for those who may be fitted in any of these performances. Finally, although the Tsuki performances from waist and from midway

did not present a remarkable difference but nevertheless, the present study well showed that the correct performance of this technique (classical performance) can have advantage in linear and angular speeds and the performance from midway can also bring the advantage of better self defending in case of counter-attack and faster reach.

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