DU Journal of Undergraduate Research and Innovation
Volume 3, Issue 2, pp 64-70

Selected Kinematics of Upper Punches (UP), Middle Punches (MP) and Lower Punches (LP) of Karate- (A Comparative Study)

Dhananjoy Shaw[1], Balaram Pani[2], Anil Bali[3], Deepika Dhiman[4] and *Pawan Kumar[5]

[1]IGIPESS, University of Delhi, Vikas Puri, New Delhi- 110018, [2]Department of Chemistry, [3]Department of Biology, Bhaskaracharya College of Applied Sciences, University of Delhi, Dwarka, New Delhi- 110075, [4]Research Scholar, University of Delhi, Vikas Puri, New Delhi-110018, [5]Department of Physical Education, Bhaskaracharya College of Applied Sciences, University of Delhi, Dwarka, New Delhi- 110075
pawan.dabas@yahoo.com

ABSTRACT

Three types of punching techniques are commonly used by the karate Upper Punch, Middle Punch, and Lower Punch. The objectives of the study is to study the angular velocity and angular acceleration of the Upper Punches (UP), Middle Punches (MP) and Lower Punches (LP) in karate. The study was conducted on nine well-trained subjects (aged between 18 to 25 years) who were randomly selected. The data was collected using digital video recording system for three trials. Angular velocity and angular acceleration were analyzed using two-dimensional video analyses (kinovea 0.8.15 software). The data was computed with Mean, Standard Deviation and 't' test. According to the findings, comparison of angular velocity between UP and MP ('t' = 2.44), MP and LP ('t' = -10.54), LP and UP ('t' = 8.68) were significantly different. Further, the comparison of angular acceleration between UP and MP ('t' = 3.09), MP and LP ('t' = -10.54) were significantly different. Whereas, comparison between LP and UP ('t' = 0.70) was not significantly different at 0.05 level. We conclude that (1) the Upper, Middle and Lower Punch have significantly different velocities with highest velocity (m/sec) in lower punch followed by Upper Punch and Middle Punch (2) Angular acceleration (m/sec) is significantly different between Upper Punch and Middle Punch as well as Middle Punch and Lower Punch and insignificantly different between Lower Punch and Upper Punch.

Key Words: Angular Velocity, Angular Acceleration, Karate Punch

INTRODUCTION

Karate essentially a striking art that uses punching, kicking, knee and elbow strikes to strike the opponent. It also uses open-handed hitting techniques called “knife-hands”. The practitioner learns defense techniques which include blocking and getting out of the way, grappling, locks and throws. Shotokan Karate is the traditional and most commonly practiced form of Karate (1)

Techniques of Karate

Techniques of karate provide stability, enable powerful movements, and with consistent practice, results in strengthening of the legs (1).

There are mainly three types of punching techniques (Tsuki) that are commonly used by the karate players (2). They are as follows:

i. Jodan Tsuki - A punch on the face section of the opponent’s body- Upper Punch
ii. Chudan tsuki- A punch on the mid-section of the opponent’s body- Middle Punch
iii. Gedan tsuki– A punch on the lower sect ion of the opponent’s body- Lower Punch

Young Kwan Kim et.al (3) explored and enquired into the kicking leg kinematics and involvement of inter-joint coordination of the leg in creating the kicking velocity used in Taekwondo. The outcome showed a push like movement and hip and knee extension produces the kicking velocity. There was a considerable hip abduction in thrashing kick and turning back than the round house kick and back kick. This new index successfully classified the thrashing kick and turning-back kick into a push-throw continuum which showed a positive change from negative index (opposite direction) to positive index (same direction) of hip and knee motions at the end of the movement. This procedure of push-throw continuum expanded the kicking velocity at the moment of impact by applying a throw like movement pattern.

Chul-Soo Ha, et al (4) (analyzed the changes in kinematics of the Bandal Chagi (Arc Kick), which is used very frequently in Taekwondo competitions which showed that playerss to apply the Bandal Chagi more effectively and must be trained to enhance knee joint, hip joint and extension in pulling back upper-body action.

Above studies motivated the researchers to study the kinematics of punches involved in karate.

Objectives of the Study

i. To study the angular velocity of Upper Punches (UP), Middle Punches (MP) and Lower Punches (LP) of karate.
ii. To study the angular acceleration of Upper Punches (UP), Middle Punches (MP) and Lower Punches (LP) of karate.

METHODOLOGY

The study was conducted on nine subjects who were randomly selected after adequate training. The subjects aged between 18 to 25 years and were of the same socio-economic status. The data was collected using digital video recording system. Each subject was

given three trials for karate punching performance. Thereafter angular speed, angular velocity and angular acceleration was analyzed using two-dimensional video analysis (kinovea 0.8.15 software).

Measuring angle

The step involved in measuring joint angle in kinovea are the following:

- Click on the angle toolbar
- Click on the center of the object(joint) for which angle is to be found out

Right click and use invert angle option if you want to measure angle of another side

Figure I: Measuring Angle

Measuring Time (t)

- Click on the Stopwatch button of the drawings tool bar:
- Click anywhere on the image to add the Stopwatch.
- The Stopwatch will be visible from this image, forward.
- One can change background color and font size through the configuration dialog box
- *One can resize the Stopwatch label by dragging the lower right corner away or by changing the font size in the configuration dialog.*
- Right click on the stopwatch on the screen and give command start/stop the stopwatch.

Figure II: Measuring time

Keeping in view the objectives of the study, feasibility and nature of the selected variables, following statistical analysis were computed namely Mean, Standard Deviation and 't' test.

RESULTS

Table – I Descriptive Statistics of Angular Velocity and Angular Acceleration of Upper Punches (UP), Middle Punches (MP) and Lower Punches (LP) of Karate

S.No.	PUNCHES	MAV (m/sec)	SDAV	MAA (m/sec)	SDAA
1	Upper Punch	432.38	179.98	1974.82	1351.81
2	Middle Punch	252.84	127.62	538.9	329.23
3	Lower Punch	1451.36	302.94	2488.68	1724.36

MAV= Mean of Angular Velocity; SDAV= Standard Deviation of Angular Velocity; MAA= Mean of Angular Acceleration; SDAA= Standard Deviation of Angular Acceleration

According to table 1, the mean (M) and standard deviation (SD) (M±SD) of the angular velocity of karate upper punches is 432.38±179.98. Likewise, M±SD of middle punches is 252.84±127.62 and M±SD of lower punches is 1451.36±302.94. The mean and standard deviation M±SD of the angular acceleration of karate upper punches is recorded as 1974.82±1351.81. Similarly, M±SD of the middle punches is 538.9±329.23

and M±SD of the lower punches are 2488.68±1724.36.

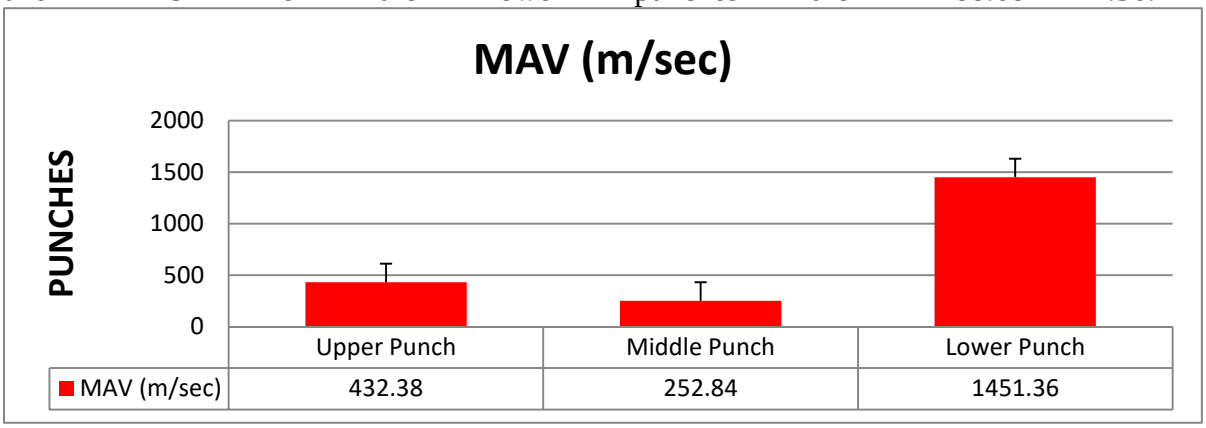

Figure III. Graphical presentation of Mean Angular Velocity (MAV)

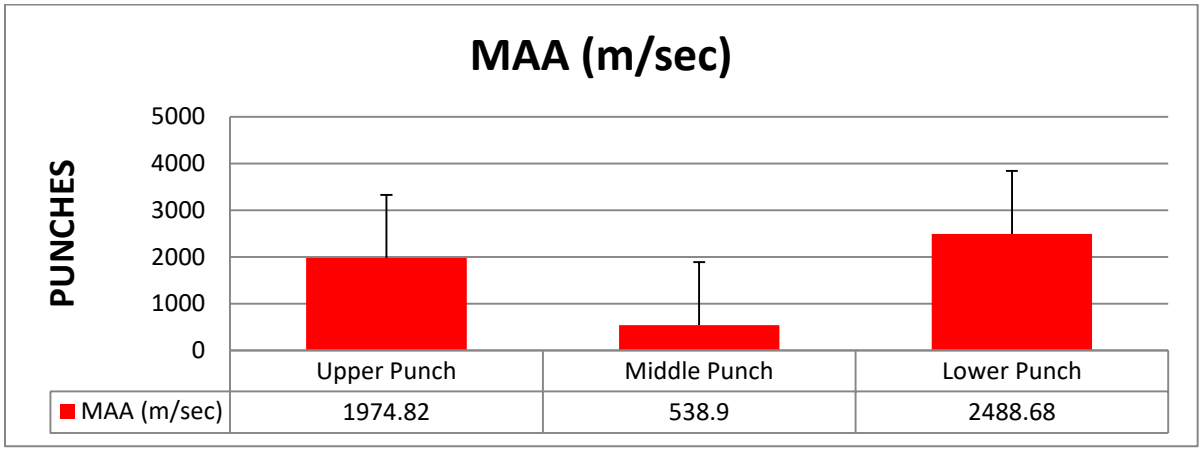

Figure IV. Graphical presentation of Mean Acceleration Velocity (MAA)

Table-II Comparison of Angular Velocity among Upper, Middle and Lower punches of Karate

Variables	MD	SED	't'
UP and MP	179.54	73.55	2.44*
MP and LP	-1198.52	109.57	-10.54*
LP and UP	1018.98	117.46	8.68*

Note: *= Significant at 0.05 level, UP= Upper Punch, MP= Middle Punch, LP-=Lower Punch, MD= Mean Difference, SED= Standard Error of Difference

According to table-2, that is comparison of angular velocity between UP and MP ('t' = 2.44) was significant (different) at 0.05 level. Similarly, comparison between MP and LP ('t' = -10.54) and LP and UP ('t' = 8.68) were significantly different at 0.05 level.

Table-III Comparison of Angular Acceleration among Upper, Middle and Lower Punches of Karate

Variables	MD	SED	't'
UP and MP	1435.92	463.77	3.09*
MP and LP	-1949.78	585.17	-3.33*
LP and UP	513.86	730.36	.70(NS)

Note: *= Significant at 0.05 level, NS= Not Significant at 0.05 level, UP= Upper Punch, MP= Middle Punch, LP-=Lower Punch, MD= Mean Difference, SED= Standard Error Difference

According to table-2, a comparison of angular acceleration between UP and MP ('t' = 3.09) and MP and LP ('t' = -10.54) is significantly different at 0.05 level. Whereas, comparison between LP and UP ('t' = .70) was not significantly different at 0.05 level.

DISCUSSION

Previous studies regarding kinematic (5,6,7,8) have shown that several fundamental movement patterns were common and training for improved acceleration should be directed towards using coaching instructions and drills that specifically train such movement adaptations.

In the present study it is understood that the angle variables will be good kinematic descriptor as well as resultant of linear kinematics for karate techniques namely middle punch, upper punch and lower punch. The results have given good directions to coaches and athletes to develop the training programs. It also provides appropriate feedback when training for improved velocity and acceleration and selection of punches in Karate.

The angular velocity is obtained by dividing the angular displacement by the time taken. The present study showed difference in angular velocity among all the three groups viz. UP, MP and LP. The Upper, Middle and Lower Punch have significantly different velocity with higher velocity (m/sec) in lower punch followed by Upper Punch and Lower Punch. It is an important factor to be considered by the coaches.

The angular acceleration is the rate at which the angular velocity of a body segment changes with respect to time. UP and MP as well as MP and LP were found to be significantly different but LP and UP were found to be insignificant. Angular acceleration (m/sec) was found to be significantly different between Upper Punch and Middle Punch as well as Middle Punch and Lower Punch. It was found to be insignificant between Lower Punch and Upper Punch. The angular acceleration was higher in lower punch followed by Upper Punch and Lower Punch.

It is postulated with regard to different velocity and acceleration pattern of Upper Punch, Middle Punch and Lower Punch are attributed to kinesiological phenomenon.

CONCLUSIONS

1. The Upper, Middle and Lower Punch have significantly different velocity with higher velocity (m/sec) in Lower Punch followed by Upper Punch and Lower Punch.
2. Angular acceleration (m/sec) is found to be significantly different between Upper Punch and Middle Punch as well as between Middle Punch and Lower Punch.

REFERENCES

1. https://www.um.edu.mt/__data/assets/pdf_file/0018/236052/Introduction_to_Karate.pdf
2. https://en.wikipedia.org/wiki/Tsuki
3. Kim, Y. K. (2011). Inter-Joint Coordination in Producing Kicking Velocity of Taekwondo Kicks. *Journal of Sports Science and Medicine*, *10*(1), 31–38.
4. Chul-Soo Ha, Man-Ho Choi, Bong-Gyung Kim (2009). The Kinematical Analysis of the Taekwondo Sparring Players' Bandal Chagi in Kinematics. *International Journal of Applied Sports Sciences*, *21*(1), 115-131.
5. Murphy A.J., Lockie R.G., Coutts A.J. (2003). Kinematic Determinants of Early Acceleration in Field Sport Athletes. *Journal of Sports Science & Medicine*. *2*(4),144-150.
6. Lockie, Robert G., Murphy, Aron J., Schultz, Adrian B., Jeffriess, Matthew D. and Callaghan, Samuel J. (2013). Influence of Sprint Acceleration Stance Kinetics on Velocity and Step Kinematics in Field Sport Athletes. *Journal of Strength & Conditioning Research 27*(9), 2494–2503
7. Colin J. G. and Mark G. L. S. (2017). A Biomechanical Analysis of The Roundhouse Kicking Technique of Expert Practitioners: A Comparison Between the Martial Arts Disciplines of Muay Thai, Karate and Taekwondo. *Plos One.* 25;*12*(8): e0182645.
8. Kim Y.K., Kim Y.H., Im S.J. (2011). Inter-joint coordination in producing kicking velocity of Taekwondo kicks. *J Sports Sci Med*. *10*:31–8