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ANALISIS GERAKAN TEKNIK PUKULAN *GYAKU TSUKI* PADA ATLET KARATE KELAS JUNIOR DI DOJO SURYA YUDHA PRESTASI

ANALYSIS OF *GYAKU TSUKI*'S PUNCH MOTION ON JUNIOR CLASS KARATE ATHLETES AT DOJO SURYA YUDHA PRESTASI

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Abstrak

Tujuan dari penelitian ini untuk menganalisis gerak pukulan *Gyaku Tsuki* pada atlet karate kelas Junior di Dojo Surya Yudha Prestasi. Jenis penelitian ini menggunakan penelitian kuantitatif dengan metode *survey*. Sampel dalam penelitian ini adalah atlet Kelas Junior di Dojo Surya Yudha Prestasi (16 - 17 tahun) yang berjumlah 11 atlet. Teknik analisis data pada penelitian ini menggunakan aplikasi *Kinovea 0.9.5*. Analisis gerakan Teknik pukulan *Gyaku Tsuki* atlet Dojo Surya Yudha Prestasi mempunyai rata-rata kecepatan 0,58 m/s, rata-rata jarak antar kaki 84,3 cm, kecepatan rata-rata pukulan 16,4 meter/s, rata-rata sudut lengan kanan saat memukul sebesar 172,1 derajat, rata-rata sudut togok sebesar 152,8 derajat, rata-rata sudut tungkai kiri 109,9 derajat, dan rata-rata sudut tungkai kanan sebesar 120,7 derajat. Kesimpulan dari penelitian ini menemukan bahwa sudut lengan kanan, sudut tungkai kiri, sudut tungkai kanan, dan sudut togok yang dibentuk sangat mempengaruhi pada kecepatan pukulan *Gyaku Tsuki*. Sehingga diperlukan koordinasi yang baik dan teknik yang benar untuk dapat mengoptimalkan Gerakan Teknik pukulan *Gyaku Tsuki*. Diharapkan pada penelitian selanjutnya dapat membahas terkait efektifitas pukulan *Gyaku Tsuki*.

Kata kunci: analisis gerak, karate, pukulan *Gyaku Tsuki*

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Abstract

The purpose of this study was to analyze the motion of the *Gyaku Tsuki* on Junior Class Karate athletes at Dojo Surya Yudha Prestasi. This type of research uses quantitative research with survey methods. The sample in this study were junior class athletes at Dojo Surya Yudha Prestasi, Banjarnegara Regency (16-17 years old), totaling 11 athletes. Data analysis techniques in this study used the *Kinovea 0.9.5* application. Analysis of the punching movement of *Gyaku Tsuki* athlete Dojo Surya Yudha Prestasi has an average speed of 0.58 seconds, an average distance between the feet of 84.3 cm, an average punch speed of 16.4 meters/s, an average right arm angle when hitting is 172.1 degrees, the average striking angle is 152.8 degrees, the average left leg angle is 109.9 degrees, and the average right leg angle is 120.7 degrees. The conclusion found that the angle of the right arm, the angle of the left leg, the angle of the right leg, and the angle of the strike formed greatly influence the speed of *Gyaku Tsuki*'s punch. So good coordination and correct technique are needed to optimize the *Gyaku Tsuki* punch movement. It is hoped that further research can discuss the effectiveness of *Gyaku Tsuki*'s punch.

Keywords: *Gyaku Tsuki* punch, karate, motion analysis

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INTRODUCTION

Sport is a systematic activity to encourage people to live their lives, in other words to form people who are physically and mentally healthy accompanied by a disciplined and sportsmanlike character and personality when carrying out sports activities. Sports coaching is a very influential factor in the development of sports achievements. Increasing sports performance depends on sports coaches themselves (Irawan, Azra, et al., 2023). Therefore, the trainer's knowledge greatly influences the quality of the process and the results obtained during training. As in (Goethel et al., 2023) who emphasized the performance of the Gyaku Tsuki punch on the athlete's reaction speed. The quality of the trainer also has an influence on producing optimal quality training programs (Ashadi, 2014). The process of achieving maximum performance in sports coaching requires a long period of time to get optimal results. (Ikram, 2022) said that the progressiveness of training has a positive impact on the consistency of the movements carried out so that when competing they are automatic. In the development of the world of sports in the current era, developing sports achievements (Irawan et al., 2023) is very important in advancing a particular sport. Support from the government, community and family is something that needs to be a priority to accompany athletes in achieving targeted achievements. For example, the sport of karate has been included as an achievement sport. Movement analysis applied in improvements and evaluations carried out in karate has a role in the effectiveness and efficiency of movements, especially in competitions. Fast and precise movements are very necessary for improving performance (Irawan et al., 2022; Irawan, Permana, et al., 2023) which includes aspects of physical condition components such as speed, agility, strength, accuracy and coordination. Sports biomechanics plays a role in providing notes, evaluations, and recommendations to improve performance.

Karate, which is translated literally as empty hands, originates from martial arts developed in Okinawa, Japan, in the early 17th century (Aguar de Souza et al., 2017; Gavagan & Sayers, 2017). (kara = empty, te = hand), explains the fact that karate involves the use of kicks, punches, and striking techniques. In the sport of karate there is one technique that must be mastered, namely: Gyaku Tsuki (punches targeting the stomach or solar plexus). According to (Matutu et al., 2019) The Gyaku Tsuki striking technique in karate is the most effective form of attack so it is very important for a karateka to master it. The Gyaku Tsuki punch technique is the fastest attack compared to the kick technique, and the Gyaku Tsuki punch technique is very easy to master. The Gyaku Tsuki punch technique is used more often than kicks to score points. This is because the blow technique is carried out within a few milliseconds (Ardelean et al., 2019). To improve technique in punch speed, you can rotate the pelvis accompanied by increasing arm muscle strength. When performing a Gyaku Tsuki punch, the faster the arm is pulled back to its original position, the faster the punch will be (Venkatraman & Nasirivanaki, 2019). According to (Adamec et al., 2021) punching technique, gender, use of the dominant hand, and body weight influence the level of punches performed. Another thing that is a point of attention is the suitability of the movements carried out (Billah & Irawan, 2022). Maximum performance of movements must be based on correct and appropriate movements. Coordination between body segments and concentration (S et al., 2019) of athletes play an important role in the locomotor movements carried out to perform optimally in competition.

The problem that arises in this research is how to understand the coordination process of hitting accuracy when carrying out an attack so that it is easy to get points. In other cases, coordination between all components of the body when practicing karate is a biomechanical element needed in sports that covers all components of the body. Accuracy when making a punch (Nugroho, Agung, 2005) is very influential in getting points, because if the hit is not on target it will turn into a foul and you will not get points. The jerk that the athlete makes when performing the Gyaku Tsuki punch must also be precise and fast. With the Gyaku Tsuki punch movement followed by a rotation of the pelvis and a jerk at the end of the arm, the athlete will

19 easily get points. So that the analysis of Gyaku Tsuki's punch can determine the contents of the movement in detail regarding the obstacles experienced by athletes and coaches during performance (Irawan, Raharja, et al., 2021).

Banjarnegara Regency is one of the District Governments that fosters two martial arts colleges, namely Lemkari and Inkai. One of the Dojos of the Banjarnegara Regency Government is the Surya Yudha Prestasi Dojo, which is currently a karate training center and contributes to martial arts achievements in Banjarnegara Regency. Dojo Surya Yudha Panggan²⁴ has 35 junior class athletes, but only 10 junior athletes and 5 senior athletes participated in the training camp. Based on the results of the competition in the provincial championship FORKI (Indonesian Karate-Do Sports Federation) and PORPROV (provincial sports competition) pre-qualification selection, the results were 2 gold, 3 silver, 5 bronze. Although these results were not in line with the target of qualifying for all of them in the pre-Proprov Qualification round, and only left 2 silver²⁹ and 2 bronze medals from the kumite athletes who passed the PORPROV Qualification round. Based on the results of the author's observations, junior class athletes at the Surya Yudha Prestasi dojo's are still not up to par in mastering the correct Gyaku Tsuki punching technique, which causes athletes to always be hesitant in making punches and their punching speed is less than optimal. The aim of this research is to analyze the movement of the Gyaku Tsuki⁵ punch technique in Junior Class Karate athletes at the Surya Yudha Achievement Dojo which can be used as information for coaches and athletes⁵ regarding the evaluation of the Gyaku Tsuki punch movement. Apart from that, researchers hope that this research can be used as a reference for further research.

METHOD

This study used quantitative descriptive research (Sugiyono, 2016) using a survey where this research wants to reveal the analysis of the ideal Gyaku Tsuki punching movement. The population in this study¹¹ were junior class karate athletes at the Surya Yudha Prestasi Dojo. The sampling technique in this research used purposive sampling. According to (Sugiyono, 2018), purposive sampling is a technique for determining samples with certain considerations. The consideration used by researchers is that the sample is Junior class athletes at the Surya Yudha Prestasi Dojo, (16 - 17 years old) totaling 11 athletes. The athlete has at least undergone a training camp at the Surya Yudha Prestasi Dojo.

This research has passed Ethical Clearance (EC) from Universitas Negeri Semarang, Indonesia with Number. 251/KEPK/EC/2023. The instrument in this study is based on analysis of the movement of Gyaku Tsuki punches in the form of data regarding movement indicators for each Gyaku Tsuki punch which has 3 phases, there are phase I (start), phase II (active), and phase III (end). The data analysis technique in this study uses the Kinovea 0.9.5 software (Bakhtiar & Irawan, 2023; Irawan, Toma, et al., 2021; Prastiwi & Irawan, 2022). This application can be slow down and mark movements so that they form lines that can be analyzed. The movement to be analyzed will be transformed by the lines into several different stages that can be observed clearly and precisely, especially the Gyaku Tsuki punch. Then the researcher coordinates with the head trainer regarding the research activities to be carried out.

The research instruments used were a digital camera, tripod, laptop and writing equipment. Once the instrument is ready, the next step is data collection. 1). Test Implementation. a) The sample received an explanation about the implementation of the test before the test began as in the research stage (Subekti et al., 2021, 2020) then was given 15 minutes to warm up. b) The camera is positioned at a distance of 5 meters perpendicular to the research sample. c) Samples are given time to use protective equipment such as hand protectors, shin protectors and foot protectors, after warming up. Samples were then paired based on their height. d) The sample has one chance to hit Gyaku Tsuki. When given the command "Go", the subject performs a Gyaku Tsuki punch. e) Samples take turns performing

Gyaku Tsuki blows from their partner. The data collection method uses a research scale (rating scale) to assess data and movement videos to see the accuracy of movements with the help of the Kinovea version 0.9.5 application which is then analyzed using the strow motion device on Kinovea to find out in more detail the desired kinematic data.

RESULTS

This research analyzes the movement of the Gyaku Tsuki punch for the Junior athletes at Dojo Surya Yudha Prestasi, Banjarnegara Regency. The existing data was then analyzed using Kinovea software version 0.9.5. The results of this research are the Gyaku Tsuki punching movements with suitability of movement based on indicators with parameters namely distance between legs (m), time (s), speed (m/s), right arm angle (°), and strike angle (°).

Table 1. Data of Athlete Achievements Dojo Surya Yudha Prestasi

n = 11	Mean ± SD	Max	Min
Age (Years)	16 ± 0,47	17	16
Height (Cm)	154,18 ± 4,62	163,00	147,00
Body Weight (Kg)	45,18 ± 4,45	57,00	40,00
BMI (Kg/m ²)	18,99 ± 1,36	21,45	17,22

(Source: research 2023)

Based on table 1, it is known that the athlete data has an average age of 16 years old, with an SD of ± 0.47. The lowest age is 16 years old, and the highest age is 17 years old. Average body height is 154.18 cm, with SD of ± 4.62 cm. The lowest body height is 147 cm and the highest is 163 cm. Average body weight was 45.18 kg, with an SD of ± 4.45. The lowest weight is 40 kg and the highest is 57 kg. The average BMI (Kg/m²) was 18.99 Kg/m², with an SD of ± 1.36 with a minimum value of 17.22 Kg/m² and a maximum of 21.45 Kg/m². From the athlete's BMI data obtained, it is still in the Normal category, where the norm range is between 18.5 – 22.9 Kg/m².

Table 2. Kinematics Data of Gyaku Tsuki Punch

Indicator	Results	Min	Max
Punch Speed (m/s)	16,4 ± 3,03	15,9	16,2
Punch Time (s)	0,58 ± 0,04	0,6	0,6
Initial Phase			
Right Arm Extension Angle (°)	72,5 ± 11,9	43,2	178,3
Right Leg Extension Angle (°)	171,8 ± 5,4	161,6	178,8
Left Leg Extension Angle (°)	153,9 ± 11,7	138,2	173,5
Punch Distance (m)	92,9 ± 13,2	70,0	114,2
Distance Between Feet (m),	60,1 ± 13,1	78,6	32,9
Active Phase			
Punch Time (s)	0,58 ± 0,04	0,6	0,6
Punch Speed (m/s)	16,4 ± 3,03	15,9	16,2
Foot Distance (m)	84,4 ± 10,5	89,6	60,5
Right Leg Extension Angle (°)	120,7 ± 14,3	97,1	144,5
Left Leg Extension Angle (°)	109,9 ± 8,3	96,8	124,6
Torque Extension Angle (°)	152,8 ± 4,1	145,6	157,4
Final Phase			
Right Arm Extension Angle (°)	73,6 ± 14,4	55,1	188,9
Distance Between Feet (m),	64,1 ± 13,8	37,0	77,0
Right Leg Extension Angle (°)	172,7 ± 10,1	154,5	188,9

Indicator	Results	Min	Max
Left Leg Extension Angle (°)	149,1 ± 14,3	136,6	179,5
Punch Distance (m)	90,9 ± 8,9	65,0	111,2

The next data presentation is the analysis of Gyaku Tsuki's punching motion which is divided into several phases. The phase division is presented in Figure 1.

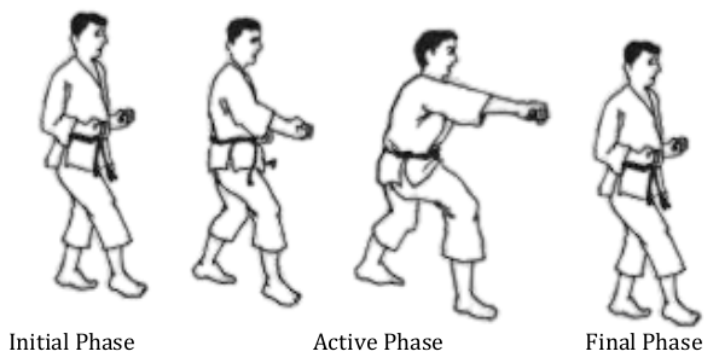


Figure 1. Gyaku Tsuki Punch Phase
 (Source: Research 2023)

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 The movement phases of the Gyaku Tsuki punch are presented in Figure 1 referring to (Venkatraman & Nasriavani, 2019), the Gyaku Tsuki punch movement is divided into 3 phases, including: 1) initial phase, 2) active phase, and 3) final phase. The preparation phase starts from the starting position to getting into the zen-kutsu-dachi stance. The stance is shoulder-width apart and the hands are on the waist. The active phase begins when the hand is moved straight forward using force in a straightforward direction and accurately towards the target, and the final phase is carried out when the hand after carrying out the active movement of the punch returns to its starting position towards the stance.

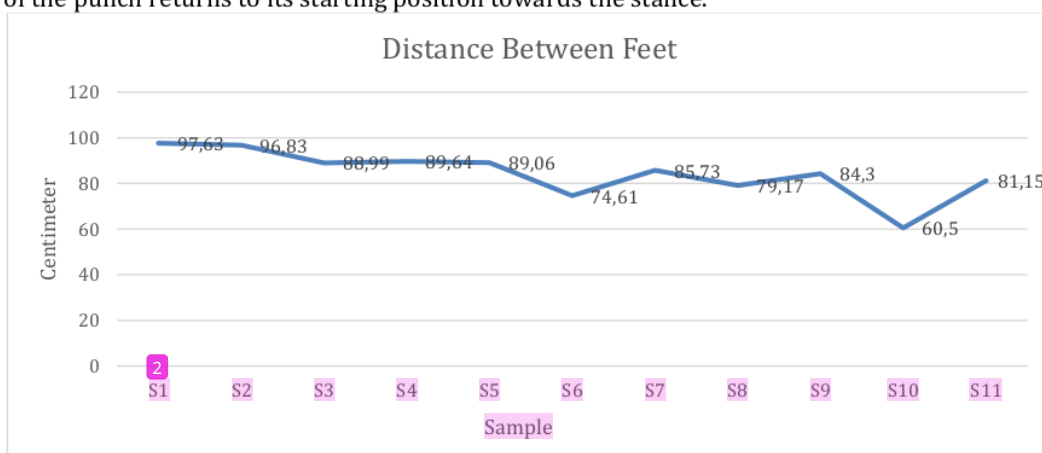


Figure 2. Data on The Distance Between Gyaku Tsuki's Punches
 (Source: Research 2023)

The results of the distance between Gyaku Tsuki's punching legs are presented in Figure

2, the leg distance is the distance between the front and back legs during the active phase, with the distance results in Sample 1 being 97.63 cm, Sample 2 being 96.83 cm, Sample 3 being 88, 99 cm, Sample 4 is 89.64 cm, Sample 5 is 89.06 cm, Sample 6 is 74.61 cm, Sample 7 is 85.73 cm, Sample 8 is 79.17 cm, Sample 9 is 84.3 cm, Sample 10 is 60.5 cm, and Sample 11 is 81.15 cm



Figure 3. Distance Between Gyaku Tsuki's Punching Feet
(Source: Research 2023)

The results of the distance between Gyaku Tsuki's punching legs are depicted in Figure 3, explaining that the distance between Gyaku Tsuki's legs in this study was measured by calculating the distance between the legs in the preparation phase. The greater the distance between the two legs causes a reduction in the power of the Gyaku Tsuki punch, and the shorter the distance between the two legs causes a reduction in the balance of body proportions when executing the Gyaku Tsuki punch.



Figure 4. Gyaku Tsuki's Phase of Punch Movements
(Source: Research 2023)

Movement in this active phase provides optimal movement potential for the strokes performed. The research results showed that the average distance between the legs was 0.93 m, and the minimum distance was 0.71 m, with the standard ideal distance between the legs being 0.81 m. The body will be less likely to fall if you regularly do balance exercises. Balance needs to be maintained by providing an ideal distance between the legs so that the possibility of falling during movement or competition can decrease significantly.

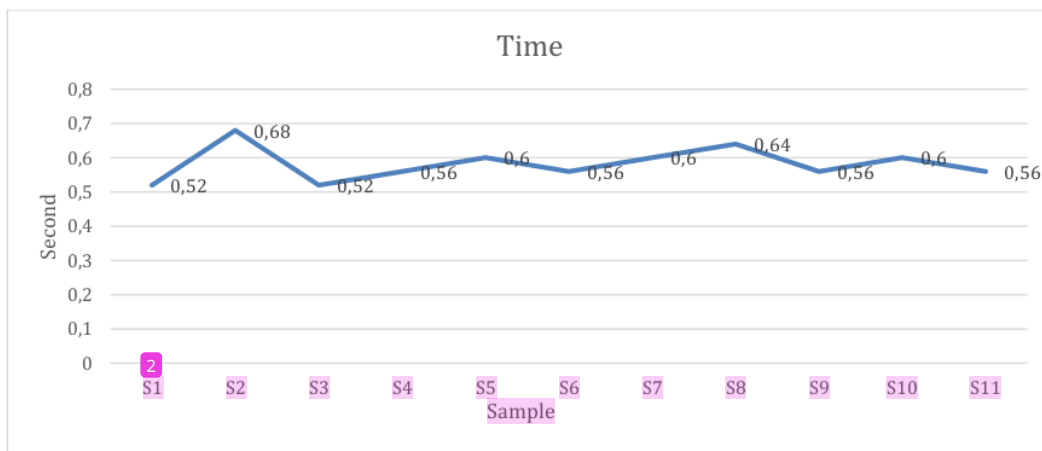


Figure 5. Gyaku Tsuki Punch Data Time
(Source: Research 2023)

Gyaku Tsuki's punch time is the time delay between throwing a punch and pulling a punch. The data is presented in Figure 4 with the results, namely: sample no.1 has a time of 0.52 seconds; sample no.2 has a time of 0.68 seconds; sample no.3 has a time of 0.52 seconds; sample no.4 has a time of 0.56 seconds; sample no.5 has a time of 0.60 seconds; sample no.6 has a time of 0.56 seconds; sample no.7 has a time of 0.60 seconds; sample no.8 has a time of 0.64 seconds; sample no.9 has a time of 0.56 seconds; sample no.10 has a time of 0.60 seconds; and sample no.11 has a time of 0.56 seconds. The lowest time is 0.52 seconds, and the highest time is 0.68 seconds. The faster the athlete is in making a punch, it indicates that the sample has an agile body. The less time it takes to make a punch or what can be called a fast strike, the greater the sample's opportunity to deliver many punches to the opponent, with the aim of scoring points in a karate competition. The longer it takes to make a blow, the slower the sample opportunity to switch movements becomes and can result in the opponent having more opportunities to make an attack.



Figure 6. Gyaku Tsuki Punch Speed Data
(Source: Research 2023)

The overall speed of Gyaku Tsuki's punches is measured by dividing the distance by the time. The data is presented in Figure 5 with the fastest hit results, namely sample n³³1 with a speed of 20.46 m/s; and the slowest blow in sample no. 8 with a speed of 10.93 m/s. The speed of the punch is obtained by looking at the distance and time lag when the punch is thrown. The greater the sample speed in carrying out movements indicates that they have good abilities in coordinating complex movements and stimulation, optimal technique, and effective and precise movements. The angle of the right leg of Gyaku Tsuki's punch is measured at the back angle of the knee. The maximum angle on the right leg is 144.5 degrees and the minimum angle is 97.1 degrees, with the ideal standard being an angle of 120-130 degrees. A right leg angle that is too large will cause the leg not to help the pelvis to push when executing the Gyaku Tsuki punch. Meanwhile, a right leg angle that is too small will cause the body's weight to lean backwards and disrupt balance and punch distance.

DISCUSSION

Analysis of Gyaku Tsuki's punching movements in karate athletes in this study provides information that with an average body mass index in the normal category and an average punching time of around 5.8 m/s, it is possible that athletes still need to increase speed training to be more efficient in hitting the target. Research conducted by (Goethel et al., 2023) found that the punch time for athletes was 0.83 s³conds for elite athletes and 0.91 seconds for sub-elites. From these data it is shown that the development of fast³ movements due to the improvement and optimization of skills related to perception and reaction as well as neuromuscular control, allows for better decision making and consequently faster reactions as shown in the Gyaku Tsuki punch¹⁴ performed by the athlete.

The series of movements in the analysis of the Gyaku Tsuki punch movement, which is divided into 3 phases, there are the initial phase, active phase, and final phase. Each phase has an influence on the results of the punches performed. In the initial phase, karateka began to be able to perform the initial stance of the Gyaku Tsuki punch quite well, although there is still something that needs to be improved. The movements include the forward leg being dragged and crossed and the hand that is going to hit is in a slightly upward position. Then, the forward position of the front leg should be crossed and dragged so that it can form a strong and good stance. Understanding related to movement analysis and monitoring needs to be considered to find out improvements and deficiencies in the movement being carried out (Gianino, 2010).

Based on research data obtained, an average foot distance of 0.93 m will make movements more precise in maintaining balance when making punch movements. Balance when making a punch with the ideal foot distance as a stance can help the acceleration of the punch to be more effective until the movement ends in an impact position with the target. Continuous and efficient movements will make the movements effective (Hadi et al., 2021; Prastiwi & Irawan, 2022) especially in Gyaku Tsuki punch to the target. Apart from that, the movements carried out in all the movements carried out in the research carried out by the athletes are quite correct, but there are things that need to be corrected, starting from the form of the Zenkutsu Dachi stance, which is too wide and not shoulder width apart, then the knees of the front legs which are bent and sometimes not parallel. with the toes and hind legs not being straight. For the upper extremity, the hand that is hitting is straight forward and the hand that is not hitting is next to chest³⁰ (hikite), the body position is upright, and the hips (kime) are pushing when hitting, the body weight is on the two legs and the gaze is focused forward. Therefore, there is a need for coordination of a group of muscles involved in the pronation movement of the wrist (Purwanto, 2022; Ruskin & Liputo, 2021) and forearm when performing normal Gyaku Tsuki which produces a higher moment which results in higher force generation as stated by (Sayyid et al., 2019). In the future, it is hoped that movements that match the speed will increase higher than the previous punches.

Further analysis of the Zen-kutsu-dachi stance with good results, as stated by (Purwanto, 2022) Where the arms are straight forward when hitting, the body weight rests on the two legs, the body is upright and the gaze is focused straight ahead of the target. The thing that is of concern is when the karateka doesn't understand the final stance technique for doing the Gyaku Tsuki punch properly and correctly. One of them is foot work (Irawan, Jannah, et al., 2021) and the reaction after taking a punch to carry out movements such as avoiding a counterattack from the opponent (Gavagan & Sayers, 2017). Recommendations given include the hand that hits straight ahead and the hand that does not hit at the side of the chest (hikite) but is ready for movement changes to improve performance (Irawan & Hidayah, 2022; Qutrotunaini et al., 2022), upright body position and hips (kime) has pushed when hitting, the body weight rests on two feet and the gaze is focused forward. When performing the final stance, the Zen-kutsu-dachi stance remains active with the arms straight forward when hitting. Next, the body weight rests on the two legs, and the body is upright, and the gaze is focused straight ahead of the hitting target. Therefore, concentration and coordination are required (Irawan, Nomi, et al., 2021) from each part of the body to be active and focused on the existing hitting target. It is hoped that the technique of this movement will be more effective for athletes to use when performing the Gyaku Tsuki punch, which is a punching technique that is widely used in karate, both in training and in competitions.

CONCLUSION

The conclusion of the research found that the average punch speed was 0.58 m/s, the average distance between the legs was 84.3 cm, and the average punch speed was 16.4 m/s. Meanwhile, the average angle of the right arm when hitting is 172.1°, the average angle of the strike is 152.8°, the average angle of the left leg is 109.9°, and the average angle of the right leg is 120.7°. In the analysis carried out, it was found that the angle of the right arm, the angle of the left leg, the angle of the right leg, and the angle of the punch formed greatly influenced the speed of Gyaku Tsuki's punch. The effectiveness of the movements carried out is influenced by the distance of the footsteps and the speed of the arms when making the punch. Good coordination and correct technique are needed to optimize the Gyaku Tsuki punching movement. It is hoped that further research can discuss the effectiveness of Gyaku Tsuki's punch. Apart from that, it is hoped that future research will discuss the factors related to Gyaku Tsuki's punch which get minimal points. The importance of studying sports biomechanics analysis in match techniques and strategies is very necessary to identify movements to be more effective and optimal on the field.

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