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KINETIC ANALYSIS USING ELECTROMYOGRAPHY AGAINST YEOP CHAGI IN TAEKWONDO POOMSAE ATHLETES STATE UNIVERSITY OF JAKARTA

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Abstract The population in this study were all 8 Taekwondo Poomsae athletes, between 4 males and 4 females. From the results of data analysis, descriptions, examiners of research results, and discussion, conclusions can be drawn, namely, Kinetic Analysis Using Electromyography Against Yeop Chagi in Taekwondo Poomsae Athletes, State University of Jakarta. The study's conclusion was declared significant if t count > t table at a significance level of 5% and p-value < 0.05. Based on the table above, we obtained an average of 40.32. It was also found that the t count > t table at the level of 5% = -4.528 to 4.528 (4.528 > 2.023) and had a p-value of <0.05, which means that it can be concluded that there was a significant increase in the result score of the Electromyography group. The t-test Pre-Test and Post-Test Yeop Chagi aims to determine whether there is an increase in the score. The study's conclusion was. Declared significant if it count > t table at a significance level of 5% and p-value <0.05. Based on the table above, we obtained an average of 1.378. It was also found that the t-count > table at the level of 5% = -8.291 to 8.291 (8.291 > 2.023) and had a p-value of <0.05, which means that it can be concluded that there was a significant increase in the result score of the Yeop Chagi group.

Keywords: Poomsae, Yeop Chagi, Electromyograph

INTRODUCTION

This article presents the features of the technical training of athletes at the initial training stage in taekwondo (Poomsae). It was shown that this stage forms the basis of all aspects of athlete readiness, which will enable them to compete effectively in the next stage. The peculiarity of Taekwondo (Poomsae), if not the Olympic direction of this sport, is rapidly increasing the requirements for the technical training of athletes, which in turn dictates the requirements for quality physical and technical training (Alexander Koshcheyev, 2020). This journal accepts article manuscripts in sports education and related disciplines. Both from academics, researchers, and professionals, nationally and internationally.

Taekwondo (Poomsae) is a type of martial art that combines various oriental martial arts. Taekwondo (Poomsae) involves the hands and feet, but they prefer the feet. Since the legs are a large group of muscles, they can provide a more substantial impact (Fachrezzy et al., 2021). Poomsae is a combination move designed to practice without an instructor, using a fixed performance base for attack and defense (AhReum & So, 2019). Poomsae is a number art that demonstrates moves in taekwondo. In this number, each athlete tries to play one or two moves alternately, and where the athlete who manages to have the highest accumulated value will be the winner. By this time, the Poomsae match had become a prestigious match and was not inferior to the kyorugi match. In every performance, Poomsae competed. Athletes who compete in Poomsae matches must have good posture and physical condition when competing. Besides that, a Poomsae athlete must also have a good mentality. Poomsae have several different types of movement.

In Poomsae, the direction, sequence, position, direction of the eye, stance, the name of the Poomsae, and the shout are all set. In Poomsae, stances, kicks, parrying, and punches require good balance and coordination (Profile of Physical Condition of Taekwondo Athletes, 2014). Especially aspects of physical exercise for Poomsae consist of 1). Powers, 2). Speed, 3). Accuracy, 4). Balances, 6). Flexibility.

In poomase, there is a ftechnique called yeop chagi. According to (Irfan et al., 2019), the yeop chagi technique is the skill of kicking the opponent's face or chest with the edge of the foot or heel. Side kicks are usually performed by turning a person's body sideways and, at the same time bending, for example, and backing them to kick the target.

In some circumstances, one can push the opponent with the feet to keep the distance from the opponent.

Meanwhile, this study has studied muscle activity and coordination in the normal shoulder with the help of electromyographic signals of leg strength based on EMG signals from the user's leg muscles because Electromyographic signals directly reflect the level of muscle activity. The EMG signal provides essential information for the leg strength to assist the robot system in understanding the user's intended movement. Therefore, it is vital to analyze the relationship between upper limb movement and associated muscle activity to help provide strength to the legs. Muscles are parts of the human body that function in the movement system. EMG serves to detect the electrical potential generated when muscles contract and relax. Muscle electrical signals can be obtained by installing EMG electrodes placed on the skin's surface on the muscle where the signal data will be taken. The embedded EMG electrode stores data for various conditions according to the placement of the electrode. So it can be used to control a system. The electrode will recognize the condition by monitoring muscle signals that match the stored data. The results of recording EMG signals have also been widely used as control signals for various systems, including computers, robots, and other devices.

There is also research on other taekwondo techniques, such as the down kick or naeryo chagi and the semicircle to the face or dollyo chagi. These studies have proven that the repetition of EMG signals in taekwondo kicks is low, which may explain some controversial muscle activity results during kicking tests. Thus, Aggeloussis et al. (2007) suggested that more than ten.

Kick repetitions should be assessed to provide reliable data for muscle function of this technique (Valdes-Badilla et al., 2018)

1. Research by Pablo Antonio V.B, Tomas Herrera. V, Mauricio Alfonso B.M and Eduardo Guzman M (2018) entitled "Differences in the electromyography activity of a roundhouse kick between novice and advanced taekwondo athletes."

Conclusion: Advanced taekwondo athletes have greater soleus and rectus femoris muscle economy than beginners and greater biceps femoris and vastus medialis activation when executing the bandalchagui kick. At the same time, they develop a maximum recruitment rate in the biceps femoris and semitendinosus muscles early in the kick cycle. The hamstring muscles are essential for the execution technique of the bandalchagui kick. In this way, taekwondo teachers, coaches, and practitioners are encouraged to incorporate exercises into their training routines to strengthen these muscle groups to improve the performance and efficiency of the bandalchagui kick.

2. Research by Saeterbakken and Vidar Andersen (2021) entitled "Electromyographic Comparison of Five Lower-Limb Muscles between Single and Multi-Joint Exercises among Trained Men."

Conclusions: These findings suggest a higher EMG amplitude of the vastus lateralis monoarticular, but not the vastus medialis, during the Multi-Joint leg exercise than the Single-Joint exercise knee extension. In contrast, the biarticular rectus femoris and biceps femoris muscles showed more significant activity during the Single-Joint exercise. In contrast, no difference in gluteus maximus activity was found between the exercises. Although one should exercise caution when using surface EMG results to prescribe resistance exercises (Vigotsky et al., 2018), these findings may suggest that the leg press could be a time-efficient approach to targeting the gluteus maximus vastus lateralis and vastus medial. Either more or as effective as a combination kickback and knee extension. Single-joint exercises may better target the biceps femoris, rectus femoris, and rectus femoris. These findings could have implications for bodybuilders and other physically oriented people who wish to target specific muscles in their training to emphasize site-specific muscle growth. However, it should be noted that the combination of knee and hip extension during the leg press may be more transferable to daily tasks (e.g., getting up from a chair or climbing stairs) and sporting movements (e.g., running or jumping). Longitudinal studies should examine how different muscle activations affect long-term adaptation to different exercises.

3. Research by Ah Reum Hong and Jae Moo So (2019) entitled "Kinematic and Kinetic Analysis of Taekwondo *Poomsae* Side Kick according to Various Heights of the Target."

Conclusion: For the target between skilled and unskilled taekwondo side kicks, this study is a detailed analysis according to scientific and quantitative data on changes in height in detailed movements through differences and similarities in performing side kicks according to the level of proficiency and changes in height. To provide primary data, the following conclusions are drawn.

1. The hip joint gradually increases in flexion, and when it hits the target, the angle of the right hip joint shows a minimum angle with maximum flexion. As the height increases, the hip joint angle shows the minimum angle. At the same time, a common feature is that the knee joint's flexion also develops. However, as the skill level increases and the skill level increases, the coordination between the hip joint and the knee joint shows a difference.

2. Looking at the angular momentum of the thigh, lower leg, and foot, the angular momentum and the unskilled and the two experienced people gradually increase according to the height, then the angular momentum decreases at E4. The higher the prowess, the greater the difference in the drop in angular momentum upon impact.

Summarizing the above conclusions, in Taekwondo Poomsae side kicks, the target height should be increased from waist height, not head height, while increasing lower extremity joint flexibility to increase joint range of motion while sequentially adjusting the height. Repeated exercise is required from the moment the foot is at a minimum angle (E3) to when the kicking foot reaches maximum extension (E4). It is assessed that exercises to strengthen the muscles necessary for the kick are also required. In addition, although this study and previous studies emphasize the importance of kicking the foot, it is deemed necessary to conduct a more in-depth study of side kicks through the ground reaction force of the supporting foot in performing side kicks.

4. Research by N. Aggeloussis, V. Gourgoulis, M (2007) entitled "Repeatability of electromyographic waveforms during the Naeryo Chagi in taekwondo."

Conclusion: EMG waveform repetition during naeryo chagi was not very high, even when ten kicks were performed. However, only the average ensemble EMG waveform obtained from more than ten kicks can represent muscle function in naeryo chagi, and conclusions drawn from one experiment should be reconsidered. While this may not apply to other taekwondo kicks, it is recommended that EMG repetitions be checked prior to an EMG investigation of the kick.

From some of the studies above, it can be concluded that there is a kinetic analysis of taekwondo using electromyography analysis. Therefore, in this study, researchers wanted to examine the results of kinetic analysis using Electromyography on yeop chagi height differences in taekwondo Poomsae athletes.

Electromyography (EMG) is a discipline that deals with the detection, analysis, and utilization of electrical signals originating from muscle contractions. The data acquisition of the electrical signal is carried out using an electromyograph instrument, and the recorded result is called an electromyogram. The characteristics of an EMG signal are random or stochastic signals whose amplitudes range from 0 to 1.5 mV (root mean square) or 0 to 10 mV (peak-to-peak) with a range of 0 – 500 Hz, with dominant energy in the range 50 – 150 Hz. Two sensors can be used to record EMG signals, namely, needle electrodes and surface (skin) electrodes. Generally, needle electrodes are used to measure the activity of single motor units and surface electrodes to measure motor units. (Ashriyah et al., 2020).

Explosive power is the ability of muscles to direct maximum strength in a very short time (Juliantine, Yudiana, & Subarjah, 2007). (Setiawan et al., 2020)

Limb muscle strength is a physical component of an increase in achievement in each sport (Adil, 2012). Leg muscle strength is a very important component to improve overall physical strength because leg muscle strength is the main driving force for any activity that involves physical activity. Muscle Strength serves as a support for all body components and also stabilizes the point of balance when kicking is done by one leg. As explained by Sajoto in D. Iskandar, (2016)

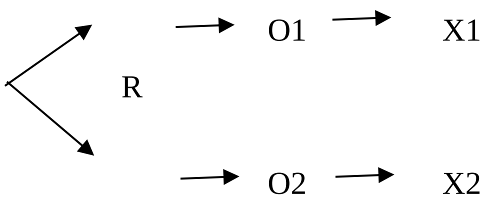
In Poomase, there is a technique called yeop chagi. According to Nam Oh (2010), the Yeop Chagi technique is the skill of kicking the opponent's face or chest with the edge of the foot or heel.

Side kicks are usually performed by turning a person's body sideways and, at the same time bending, for example, and backing them down to kick the target. In some circumstances, one can push the opponent with the feet to keep the distance from the opponent. Specifically, side kicks require body contraction when transferring energy to the target to obtain maximum thrust or thrust (Headquarters World Taekwondo, 2012).

METHOD

This study aims to find scientifically accurate answers about Kinetic Analysis Using Electromyography Against Yeop chagi in Poomsae Taekwondo Athletes, State University of Jakarta. In detail, the objectives of this study are: There are differences in the results of yeop chagi skills between Electromyography in Poomsae Taekwondo Athletes, State University of Jakarta. The research for this thesis was conducted at the Flats of the Faculty of Sports Science, State University of Jakarta, Rawamangun, East Jakarta.

The type of research used in this research is True Experimental research. Associative research aims to determine the relationship between two or more variables. Associative research has the highest level when compared to comparative descriptive research. With this associative research, it will be possible to build a theory that can function to explain, predict and control a symptom (Sugiyono, 2018). While the analysis approach used is associative analysis. (Syofian Siregar, 2013) said Associative analysis is a form of research data analysis to test whether there is a relationship between the existence of variables from two or more data groups. The variables used are independent (independent) and dependent (dependent) variables, which include 'Kinetic Analysis Using Electromyography Against Yeop Chagi in Poomsae Taekwondo Athletes, Jakarta State University". This research involves one dependent variable, namely Yeop Chagi, and one independent variable is Electromyography. The relationship between the related variables in this study is described as follows:



Information:

1. R = Random

2. O1 = Pre-Test (Pre-Test) Yeop Chagi Group
3. O2 = Pre-Test (Pre-Test) Electromyography Group
4. X1 = Treatment
5. X2 = Treatment
6. O3 = Final Test (Post-Test) Yeop Chagi Group
7. O4 = Final Test (Post-Test) Electromyography Group

RESULTS AND DISCUSSION

A. Data Decryption

This research includes experimental research. The research data consisted of a pre-test and a final test of the material delivered using Electromyography. The study was carried out from April 8 – to May 27, 2022. This study raised the research variable, namely the independent variable yeop chagi with Electromyography, and the dependent variable, namely the result value. The data on the athlete's scores were obtained using a multiple-choice test.

In this study, researchers obtained data from the Pre-Test and Post-Test results conducted in the experimental and control classes. The pre-Test is an ability test given to athletes before being treated, while Post-Test is carried out after athletes receive treatment. These two tests function to measure muscle strength related to high kicks. Each athlete will take five kicks to get the highest result, so eight athletes in 5 kicks for a total of 40 are valid.

To provide a clearer picture, the research data were grouped based on the experimental group and the control group:

1. Electromyography Pre-Test

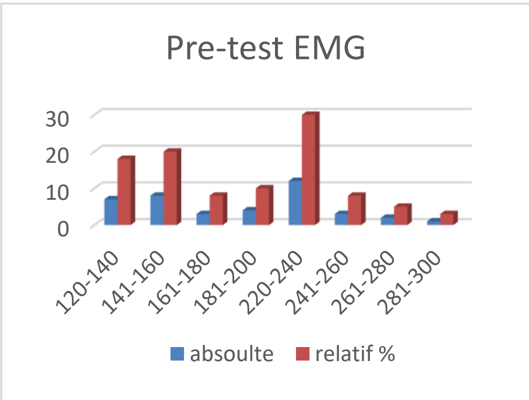
Table 1 Pre-Test Electromyography

Statistics

Pre-test EMG

N	Valid	40
	Missing	0
Mean		190.1500
Median		197.0000
Mode		220.00
Std. Deviation		45.62082
Minimum		121.00
Maximum		284.00

The results of calculations with SPSS 26 in the pre-treatment (pre-test) in the experimental class obtained a valid sample size of 40, mean score = 190.15,



mean value = 197.0 standard deviation = 45.62, minimum value = 121 and maximum value 284.

Based on the Pre-Test frequency distribution table, the experimental class can be depicted in the histogram below:

Figure 1 Pre-Test EMG

Based on the table and histogram above, most experimental class pre-test frequencies are in the 220-240 interval with 12 valid (30%).

2. Post-Test Electromyography

Table 2 Post-Test Electromyography

Statistics

posttest_emg

N	Valid	40
	Missing	0
Mean		219.0250
Median		214.0000
Mode		200.00[a]
Std. Deviation		38.57825
Minimum		160.00
Maximum		324.00

a. Multiple modes exist. The smallest value is shown

The results of the SPSS 26 calculation after treatment in the experimental class obtained a valid score of 40, the mean score = 219.02, the mean = 214, standard deviation = 38.57, the minimum value = 160 and the maximum value = 324.

Based on the frequency distribution table for the Post-Test experimental class, the data is depicted in the histogram below:

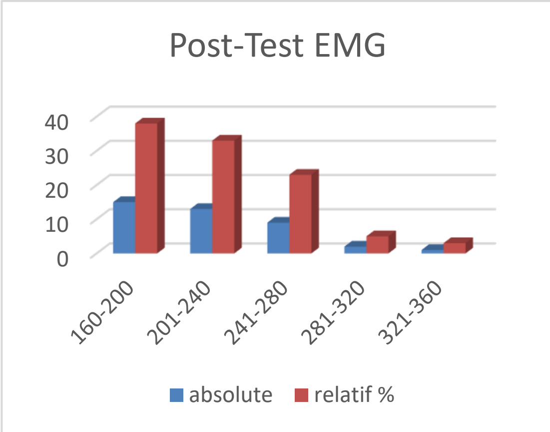


Figure 2: Post-Test EMG

Based on the table and histogram above, the majority of the experimental class's Post-Test frequency lies in the valid interval of 15 (38%)

3. Pre-Test Yeop chagi

Table 3 Pre-Test Yeop Chagi

Statistics

PretestKon

N	Valid	40
	Missing	0
Mean		44.6525
Median		44.2500
Mode		49.70
Std. Deviation		2.61465
Minimum		40.10
Maximum		49.70

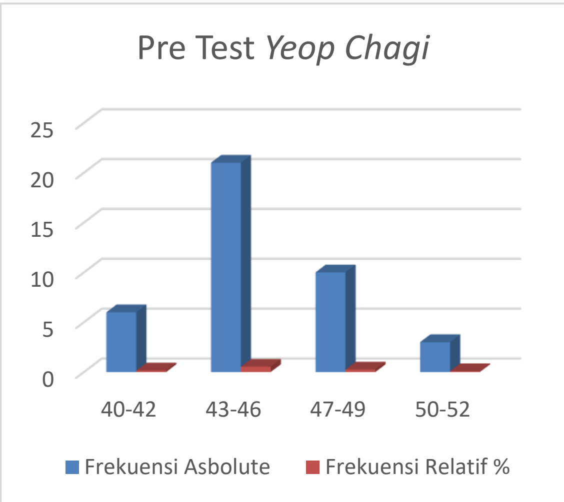
The results of the SPSS 26 calculation after treatment in the control class obtained a valid score of 40, the mean score = 44.65, the mean = 44.25, the standard deviation = 2.61, the minimum value = 40, and the maximum value = 49.7.

To simplify calculations in SPSS 26, units of degrees are converted to percent by the formula:

$$x/360 \text{ times } 100$$

Based on the frequency distribution table for the Post-Test experimental class, the data is depicted in the histogram below:

Figure 3: Pre-Test Yeop Chagi



Based on the table and histogram above, the majority of the experimental class's Post-Test frequency lies in the valid interval of 21 (53%)

4. Post-test Yeop Chagi

Table 4 Post-Test Yeop Chagi

Statistics

PostestKon

N	Valid	40
	Missing	0
Mean		46.4600
Median		46.6000
Mode		46.40[a]
Std. Deviation		2.42580
Minimum		41.20
Maximum		50.00

a. Multiple modes exist. The smallest value is shown

The results of the SPSS 26 calculation after treatment in the control class obtained a valid grade of 40, the mean score = 46.46, the mean = 46.6, standard deviation = 2.42, the minimum value = 41 and the maximum value = 50

Based on the post-test frequency distribution table for the experimental class, the data is depicted in the histogram below:

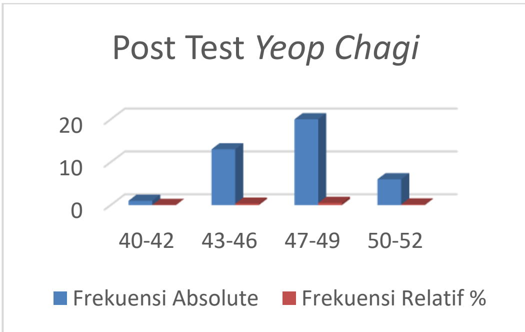


Figure 4: Post-Test Yeop Chagi

Based on the table and histogram above, most of the experimental class's

Post-Test frequency lies in the valid interval of 20 (50%).

B. Testing Requirements Analysis

1. Data Normality Test

A normality test is conducted to test whether all variables have normal distribution or not. The normality test uses the Shapiro Wilk formula in calculations using the SPSS 26.00 program. To know whether it is normal or not is, if sig > 0.05, then normal, and if sig < 0.05, it can be said to be abnormal. The calculation results obtained are as follows:

Table 5: Data Normality Test

No	Kelompok	Sig (Signifikasi)	Kesimpulan
1	*Pre-Test* EMG	0,107	Normal
2	*Post-Test* EMG	0,141	Normal
3	*Pre-Test Yeop chagi*	0,167	Normal
4	*Post-Test Yeop chagi*	0,072	Normal

Based on the table above, it can be seen that the Pre-Test and Post-Test data from both the experimental class and the control class have a sig value > 0.05, so it can be concluded that the data group is normal.

2. Homogeneity Test

The homogeneity test was used to determine the level of similarity of variance between the two groups, namely the experimental group (Electromyography) and the control group (yeop chagi), to accept or reject the hypothesis by comparing the sig value on Leven's statistic with 0.05 (sig > 0.05) the results of the homogeneity test can be seen in the table:

Tabel 6 Homogenity Test

Levene Statistic		Df1	Df2	sig
Based on mean	56,323	3	156	.000

The homogeneity test results of the research variables are known to be F-count = 56,323 with a significance value = 7,608. Therefore, from the calculation results, the significant value of this data, which is greater than 0.05 (sig > 0.05), can be concluded that the data in this study has a homogeneous variance.

C. Hypothesis Testing

This study aims to determine the difference between electromyography and yeop chagi in improving the results of taekwondo Poomsae. The analysis used is the t-test with the help of SPSS version 26, which can be explained in detail as follows

Tabel 7 Homogeneity Test

mean		St. Deviation	t	df	sig
Pretest EMG – PostTest EMG	-28.875	0.328	4.528	39	.000
Pretest YC– PostTest YC	-1.8075	1.378	-8.291	39	.000

2. Pre-Test and Post-Test Electromyography

Pre-Test and Post-Test Electromyography aim to determine whether there is an increase in the score. The study's conclusion was declared significant if t count > t table at a significance level of 5% and p-value < 0.05. Based on the table above, we obtained an average of 40.32. It was also found that the t-count > t table at the level of 5% = -4.528 to 4.528 (4.528 > 2.023) and had a p-value of <0.05, which means that it can be concluded that there was a significant increase in the result score of the Electromyography group.

3. T-Test Pre-Test and Post-Test Yeop chagi

The t-test Pre-Test and Post-Test Yeop Chagi aims to determine whether there is an increase in the score. The study's conclusion was declared significant if t count > t table at a significance level of 5% and p-value <0.05. Based on the table above, we obtained an average of 1.378. It was also found that t-count > t-table at the level of 5% = -8.291 to 8.291 (8.291 > 2.023) and had a p-value of <0.05, which means that it can be concluded that there was a significant increase in the result score of the Yeop Chagi group.

4. Post Electromyography T-Test and Post Yeop chagi

Tabel 8 Group Statistics

	Class	N	Mean
Results	Post-Test EMG	40	219,02
	Post-Test Yeop Chagi	40	46,46

Tabel 9 Independent Samples Test

	Leven's Test For Equality of Variances		t-test for Equality of Means		
	F	Sig	t	df	Sig (2-tailed)
Equal variances assumed	59,705	000	28,23	78	000

	t-test for Equality of Means		95% Cofindence Interval of the Difference	
	Mean Difference	Std. Error Difference	Lower	Upper
Equal variances assumed	172,565	6,111	60,397	84,732

Based on the output table of "Group Statistics" above, it is known that the number of data on athlete results for electromyography and yeop chagi is 40 valid. Furthermore, the average score for athletes or the mean for Electromyography is 219.02, while for Yeop Chagi, it is 46.46. Thus, statistically descriptive, it can be concluded that there is a difference in the average athlete's results between Electromyography and Yeop Chagi. Furthermore, to prove whether the difference is significant (significant) or not, we need to interpret the output of the Independent Samples Test.

Based on the output above, the value of sig. Levene's test for equality of variances is 0.000 < 0.05, which means that the data variance between Electromyography and Yeop Chagi is not homogeneous or not the same. So that the interpretation of the independent samples test output table above is guided by the values contained in the "equal variances assumed" table.

Based on the output table "independent samples test" in the section "equal variances assumed; sig value is known. (2-tailed) of 0.000 < 0.05, so as the basis for decision making in the independent samples t-test, it can be concluded that H0 is rejected and H1 is accepted. Thus, there is a significant (significant) difference between the average athlete's results on Electromyography and Yeop Chagi. Furthermore, from the output table above, it is known that the "mean difference" value is 160, 397. This value shows the difference between the average results of athletes on yeop chagi or 219.02 – 46.36 = 172.56, and the difference between these differences is 160, 39 to 184.73 (95% Confidence Interval of the Difference Lower Upper)

CONCLUSION

Side-leg locomotive kicks to waist height appeared significantly faster than other locomotive kicks (p<0.05). The relatively higher EMG activity of the rectus femoris, vastus lateralis, and vastus medals during kicking at eye level was demonstrated in this study. In addition, the EMG activity of the quadriceps group was significantly higher in the hindfoot roundhouse kick. The higher level of EMG activity may be explained by the more significant muscle load or the rapid contraction during kicking. The results show that the target's height changes make the proficiency and height lower, and the joint coordination between the hips and knees improves.

Also, the higher the target's height, the greater the angular momentum of the thigh, calf, and leg becomes common.

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