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Measurement of Medial Head Gastrocnemius Muscle Contraction Strength in Basic Sepak Takraw Techniques Using Electromyogram Signals

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ABSTRACT
This study aims to measure the strength of contraction of the gastrocnemius medial head muscle in basic techniques sepak sila using electromyogram signals. The subjects in this research were 3 South Sulawesi sepak takraw athletes. EMG signal measurement using the Trigno™ Wireless EMG System. The output data is the results of the EMG signal, the Root Mean Square value of each muscle component measured. The data analysis technique uses quantitative descriptive. The results of EMG signal measurements produce RMS values for each muscle measured as follows: (1). The subject produced the largest first EMG signal from the right gastrocnemius medial head muscle, 0.44631mV with an RMS value of 93.009mV, and the largest left gastrocnemius medial head muscle, 0.33889mV with an RMS value of 61.302mV. (2). The subject produced the second largest right gastrocnemius medial head muscle EMG signal of 1.66238mV with an RMS value of 38.7856mV, and the largest left gastrocnemius medial head muscle of 1.37871mV with an RMS value of 25.6827mV. (3). The subject produced the third largest right gastrocnemius medial head muscle EMG signal of 2.02191mV with an RMS value of 76.7969mV, and the largest left gastrocnemius medial head muscle of 0.37397mV with an RMS value of 47.3252mV. It was concluded that the third subject produced the highest muscle EMG strength which occurred in the right gastrocnemius medial head muscle signal and the smallest EMG signal in the left gastrocnemius medial head.

Keywords: *Muscle; Gastrocnemius Medial Head; Strength; Sepak Sila; Sepak Takraw.*

INTRODUCTION

Some Science and Technology (IPTEK) findings in the field of computer-based sports have been able to meet the expectations of athletes and coaches in terms of improving performance. In this way, improving the athletes' abilities can be achieved more quickly and more efficiently, where the application of computer technology is useful in providing various information about movement analysis in a sport. Movement analysis in sports has the main goal of improving athletes' abilities and reducing the risk of injury. Analyzing the movements carried out by athletes can be used as biofeedback (correction) for the movement techniques carried out by athletes to improve the quality of basic techniques in sports (W.-H. Tai, R. Zhang, and L. Zhao, 2023).

Improve the quality of basic techniques, especially in sepak takraw, it starts with identifying which muscle performance is more dominant in performing basic techniques. The results of identifying muscle contractions in athletes when performing basic sepak takraw technical movements such as sepakmula, sepak sila and smash, can provide an understanding of the nature and function of body movements and can be used as material in compiling and developing appropriate training programs for athletes, so that the use of muscle groups can be achieved. work longer, can reduce fatigue, and can avoid sports injuries in athletes (M. N. Jawis, R. Singh, H. J. Singh, and M. N. Yassin, 2005; K. Udomtaku and K. Konharn, 2020)

From the identification results, the basic sepak takraw technique movement is that it predominantly uses upper leg muscles and lower leg muscles such as the thighs, feet and ankles, while other muscles are more supportive. The sepak takraw movement is a movement that requires high intensity in a short time, especially when performing the basic smash technique, basic block technique, and basic service technique, which if you observe the movement does not take more than 1 - 5 seconds and the muscle contractions in the basic sepak takraw technique predominantly use fibres. fast muscles (fast switch fibres) compared to slow muscle fibres (slow switch fibres) (I. Iyakrus and A. Ramadhan, 2021).

The form of basic sepak takraw technical movements occurs which is influenced by several forces. Force is nothing but muscle contraction. Aryulina revealed that muscle is a connective tissue in the body whose main task is contraction. When muscles move actively they cause stretching or contraction. Muscle contractions function to move or move body parts and substances in the body. There are three types of muscle cells in the human body (cardiac, striated and smooth) but those that play a role in the movement of the human body's skeleton are skeletal/striated muscles (N. J. Campbell and C. V. Maani, 2023; H. D. Dave, M. Shook, and M. Varacallo, 2023). Muscles are composed of muscle cells whose job is to move various parts of the body. Muscle tissue is special, that is, it can contract and relax due to the presence of muscle fibres. Each muscle fibre contains several sarcomeres with the protein actomyosin (a combination of fine filaments of actin and coarse filaments of myosin). When contracted, the sarcomere shortens and returns to its original position when relaxed. For this reason, muscle cells have special structures in the cytoplasm known

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as contractile fibres. Muscle tissue has plasma called sarcoplasm (muscle cell plasma membrane) and muscle membrane called sarcolemma (H. L. Sweeney and D. W. Hammers, 2018; S. Pham and Y. Puckett, 2023).

In basic sepak takraw techniques, for example basic sepak takraw techniques, the muscles will contract more so that they can move faster or stronger. Nomiyasari explained that the greater the muscle exerts force, the greater the frequency. The EMG signal has a frequency range in the dominant energy between 20-500 Hz, with an amplitude between 0-10 mV (K. Udomtaku and K. Konharn,2020). To train the muscles so they can do the job correctly and the muscles gradually become stronger, meaning performance will increase if there is an electrical influence or vibration from outside the body. When a muscle contracts, it means that there is a contraction of the muscle fibres (muscle fibre contraction). This contraction of the muscle fibres is followed by electrical activity (S. Pham and Y. Puckett, 2023). The presence of electrical activity during these contractions means that the size of the contraction can be measured. One tool that can be used to measure muscle contractions based on electrical activity is electromyography (T. Klotz, L. Gizzi, U. Ş. Yavuz, and O. Röhrle, 2020).

Electromyography, abbreviated as EMG, is a process of detecting, analyzing and utilizing electrical signals originating from muscle contractions, while the signals obtained are called electromyograms or myoelectric signals. An EMG device will record the EMG signal generated in a muscle by stimulation of its nerves. The harder the physical performance, the greater the effort made by the muscle. At rest the muscle does not release electricity, but if the muscle contracts voluntarily an action potential can be recorded (T. Klotz, L. Gizzi, U. Ş. Yavuz, and O. Röhrle, 2020; V. Gohel and N. Mehendale, 2020).

EMG signals in muscles can be obtained by installing an electrode placed on the surface of the skin. Electrodes can store data on various conditions according to the placement of the electrodes so that they can be used to control a system and electrodes attached to muscle groups will recognize conditions by monitoring muscle EMG signals following the stored data. The electrodes are placed directly on the muscles that will be observed by attaching them to the surface of the skin to detect signals from muscle movement. The captured signal covers the area given the electrode. As a result, the signal obtained is the sum of all existing signals. Because the contraction and relaxation processes of each muscle in this area do not coincide, the signal obtained appears to be a random signal. The working principle of EMG is to measure muscle potential, as it is known that muscle activity will give rise to action potentials. The electrical potential in the muscles occurs due to chemical reactions in the muscles. In EMG examination, because it is difficult to isolate single muscle cells, EMG signal recording is always carried out for several muscle fibres. Chalimatus states that the electrical signal of a muscle or group of muscles takes the form of a noise-like wave ("noise") whose amplitude varies with muscle activity. In moderate contractions, the amplitude is approximately 1 mV for 100 Hz < frequency < 500 Hz and 0.5 mV for 500 Hz < frequency < 2000 Hz (2009, para. 5) (T. J. Roberts and A. M. Gabaldon, 2008; S. Fukuhara, T. Kawashima, and H. Oka, 2021).

The use of EMG in sports is used to clinically analyze athlete fitness through information recorded from an athlete's muscle signals, but the application of EMG in Sports Science in Indonesia is something new. Nareswari revealed that the application of biomechanics and EMG technology was first implemented in Indonesian sports in 2016, namely in the Satlak Prima Program, and then similar technology will continue to be implemented to advance Indonesian sports achievements (Sports Channel Indonesia, 2016, January, 31).

There are various applications for using EMG signals, one tool for measuring an athlete's EMG signal is the Trigno™ Wireless EMG System. The general function of this software is to process data or commands/instructions until it gets a result or executes a command. The Trigno™ Wireless EMG System device is used to record EMG signals produced by certain muscles, then the EMG signals are recorded via electrodes placed on the surface of the skin, and then the muscle activation patterns are converted into visual or recorded signals and observed by the instructor as feedback by the athlete (J. P. Ahtiainen and K. Häkkinen, 2009).

The results of identifying muscle EMG signals in athletes when carrying out movements in the sepak takraw sport can be used as evaluation material for coaches in preparing and developing appropriate training programs for athletes so that the use of muscle groups can be able to work longer and can reduce fatigue and can avoid the occurrence of sports injuries in sepak takraw athletes (J. P. Ahtiainen and K. Häkkinen, 2009; J. Sun, G. Liu, Y. Sun, K. Lin, Z. Zhou, and J. Cai, 2022).

If you know movement analysis and the magnitude of the EMG signal that occurs in an athlete's body, a coach can provide biofeedback to the athlete in preparing and evaluating training programs that are right on target to improve the athlete's performance (T. J. Roberts and A. M. Gabaldon, 2008).

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Several studies on measuring muscle contractions using EMG signals have been carried out, in 2009 by Nissan Kunju in the field of Biomedical Engineering, researching to determine the walking standards of normal people. Data analysis in this research was carried out offline using the Biometrics Management Software tool with the main parameters being signal amplitude and frequency data. There are so many benefits of EMG signals that can be applied in various fields of science, especially in the field of sports, but research on EMG signals to determine the contraction of the medial head gastrocnemius muscle when performing basic sepak sila techniques in the sepaktakraw sport has never been carried out, so through this research It is hoped that information can be obtained about muscle contractions that occur during basic sepak sila technique movements in the sepaktakraw sport (T. J. Roberts and A. M. Gabaldon, 2008).

LITERATURE REVIEWS

Muscle Contraction (Musculoskeletal)

According to Wiarto, muscle is a connective tissue whose main task is to contract, which functions to move parts of the body whether consciously or unconsciously. About 40% of the body's weight is muscle and the human body has more than 600 skeletal muscles. Contractions occur through a sliding filament mechanism, due to the formation of a cross-bridge composed of myosin and actin filaments, which will pull the actin towards the myosin (middle). The power to pull is obtained from the ATP available in the myosin heads and will be active when the action potential reaches the muscle (N. J. Campbell and C. V. Maani, 2023; S. Pham and Y. Puckett, 2023).

Muscle contractions can occur due to shortening of the myofibrils due to motor nerve impulses. First, commands are issued from the brain in the motor area and then through the spinal nerves, nerve impulses are transmitted to receptors in the muscles in the form of motor-end plates. Meanwhile, muscle fibres consist of two types of fibres, namely type I muscle fibres, slow fibres, red fibres, or slow oxidative fibres (slow-twitch muscle fibres) and type II muscle fibres, fast fibres, white fibres, or anaerobic muscle fibres (fast -twitch muscle fibre). Type II fibres are still divided into two types, namely type IIa and type IIb. So it can be classified into 3 types of muscle fibres, namely type I (slow twitch oxidative), type IIa (fast twitch oxidative), and type IIb (fast twitch glycolytic) (H. L. Sweeney and D. W. Hammers, 2018; S. Pham and Y. Puckett, 2023).

Definition of Electromyogram

Muscle function plays an important role in every human activity, for example working, exercising, studying and even sleeping, which cannot be separated from muscle performance.

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Khushaba (2010) explains that muscles are parts of the human body that function in the movement system. One way to analyze muscle performance can be obtained from its electrical activity. The electrical signal obtained is also called an electromyogram (EMG) or EMG signal. The EMG signal is one of the important signals that show human muscle activity, whereas record EMG signal data has the characteristics of a fairly small amplitude (0-10 mV) and a frequency in the range of 20-500 Hz, supporting circuits such as a differential amplifier, low pass filter, are needed. high pass and notch filter. Nomiyasari explained that the greater the muscle exerts force, the greater the frequency. The EMG signal has a frequency range in the dominant energy between 20-500 Hz, with an amplitude between 0-10 mV (G. Kamen and G. E. Caldwell, 1996; M. del Olmo and R. Domingo, 2020).

Benefits of an Electromyogram

Hasma explained that EMG functions as a bioelectrical muscle potential recorder during muscle movement and functions to obtain information about muscle electricity. There are many benefits to using EMG signals, including in the fields of health research, medical rehabilitation, ergonomics and sports science. In the field of health research, EMG signals are useful for identifying problems regarding orthopaedics, surgery, functional neurology, gait and posture analysis. EMG signals are even used in the field of medical rehabilitation, where EMG signals are useful for identifying neurological problems, rehabilitation, physical therapy, and so on. Meanwhile, the use of EMG signals in the field of sports science is widely used by sports laboratory centres for biomechanics, sports rehabilitation, athlete strength training and analyzing movement through information recorded from an athlete's muscle EMG signals. There are so many benefits that can be applied in various fields that EMG was chosen as the object of this research (S. E. Nishi, R. Basri, and M. K. Alam, 2016; M. del Olmo and R. Domingo, 2020).

Electromyogram Signal Characteristics

Nomiyasar explains that the characteristics of EMG signals are random or stochastic signals whose amplitude ranges from 0 to 1.5 mV (rms = root mean square) or 0 to 10 mV (microvolts) with a frequency range between 0 – 500 Hz. The electrical potential on the surface of the body's muscles has a voltage range of 0.4 mV to 5 mV.[19] The mechanism for generating electrical signals in muscles is closely related to the concept of a motor unit or motor unit. Motor units (MU) in a central nervous system are arranged in levels. The cortex sends signals to the spinal cord (spinal cord). The spinal cord then transmits the signal to the motor neurons (motor nerve cells) in the muscles. Motor neurons together

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with muscle fibres form the MU. Therefore, when motor neurons are activated by signals from the spinal cord, muscle fibres will also be activated to produce movements according to brain commands. Criswell (2010) explains that the number of MUs in a muscle varies from 100 to 1000. Apart from that, the forces produced by each MU also vary and are different from each other. The difference can reach 100 times or more. The source of the EMG signal is an action potential from the MU, known as the motor unit action potential (MUAP), which is generated during muscle contraction. The number of MUAPs activated does not occur synchronously. This MUAP is captured by electrodes placed on the surface of the skin to capture EMG signals (Eleanor Criswell, 2011).

Electromyogram Signal Measurement

EMG signal measurements are carried out in two ways, namely through the method of implanting electrodes and without implanting electrodes in the athlete's body; Intramuscular Method. In this method, the installation process must be carried out by someone who is trained or professional (such as a physiatrist, neurologist, or physical therapist) because it is done through a surgical operation. To measure intramuscular EMG signals, an electrode needle or needle contains two electrodes in the form of fine wires that are inserted through the skin into muscle tissue. In some cases, there is discomfort when the needle is inserted, so the electrode implantation method (intramuscular) is less preferred and avoided; Surface EMG method. This method without implanting electrodes tends to be more practical because the electrodes are only placed or attached to the surface of the skin on the muscle from which the electrical signal data will be taken. This is because the installation of a young surface electrode does not interfere with the activities (M. B. I. Reaz, M. S. Hussain, and F. Mohd-Yasin, 2006; F. D. Farfán, J. C. Politti, and C. J. Felice, 2010).

Electrode Placement

Recording EMG signals depends on various needs or situations. There is no definite conclusion regarding the placement of active electrode positions as to which position is the best, but several researchers suggest using the side of the muscle that is easiest to stimulate, as the best location for electrode placement. The following is an overview of the recommended electrode placement locations of muscle fibres. The following is an overview of the recommended electrode placement locations of muscle fibres. Of the person being studied. For this reason, the method for measuring EMG signals in this study uses a method without implanting electrodes or using surface EMG (M. B. I. Reaz, M. S. Hussain, and F. Mohd-Yasin, 2006; T. Triwiyanto, T. Rahmawati, P. Alit Pawana, E. Evrinka, and H. Maulidia, 2022).

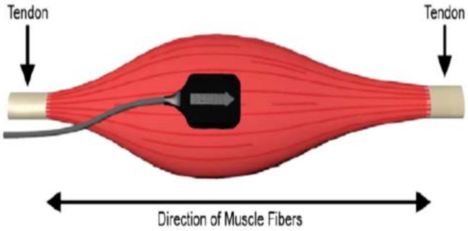

Figure 1.
Placement of electrodes on muscle fibres. (Delsys. Inc, 2013

Trigno™ Wireless EMG System

Trigno™ Wireless EMG System is a tool that can detect, record, and analyze electrical signals originating from muscle contractions. EMG signal measurements are recorded using an electrode attached to the surface of the athlete's skin and then processed using software connected to the Trigno™ Wireless EMG System. Software for sending data from electromyograph hardware to personal computers using the internal sound card of a PC/Laptop. The data is processed with Trigno™ Wireless EMG System software and the EMG signal results can be displayed. The unit of measurement for the classic display is the thickness from the positive peak to the negative peak in units of microVolts (mV). The classic display is then processed into a display that is easier to understand, read and interpret with the help of Trigno™ Wireless EMG System software (M. del Olmo and R. Domingo, 2020).

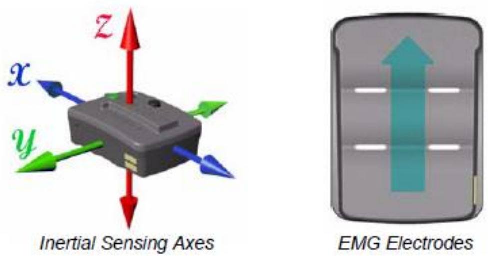

Figure 2.
Trigno wireless 4-channel sensor by Delsys, 2013

Figure 3.
Trigno base station by Delsys, 2013

Basic Techniques for Sepak Sila in the Sepak Takraw Sport Branch

Sepak takraw is a fast and action-packed sport played on a field with two teams facing each other separated by a net (K. Udomtaku and K. Konharn, 2020). The movement elements of the sepak takraw game are a combination of several types of sports, namely combining football and gymnastics. A team in the sport sepak takraw consists of three athletes: feeders, spikers/servers, and spikers/killers. Sepak takraw has three special positions including setter, server and spiker who carry out tasks such as passing, baiting, and smashing. In carrying out basic technical skills sepak takraw is an inseparable unit, without mastering the basic playing techniques, sepak takraw cannot be played well (I. Iyakrus and A. Ramadhan, 2021; D. Bakti Saputro, 2017).

Susnadi explains that the sepaksila functions as an initial kick (serve) or kick start, to receive a smash and immediately connect it and direct it to the left or right flank, and finally to provide a pass to the athlete in charge of attacking.

Figure 4.
Basic sepak sila techniques by Australian Sepaktakraw, 2014.

METHOD

Types of research

Research methods are a scientific way to obtain data with specific purposes and uses. This research is survey research with quantitative descriptive methods. The descriptive research method is "research intended to investigate circumstances, conditions or other things that have been mentioned, the results of which are presented in the form of a research report", while quantitative research is a method for testing theories specific way by examining the relationship between variables. These variables are measured (usually with research instruments) so that data consisting of numbers can be analyzed based on statistical procedures.

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Research Objects and Subjects

Research Object

The research object is the problem being studied. objects/subjects that have certain qualities and characteristics determined by researchers to be studied and then conclusions drawn, so that the object in this research is the results of measuring muscle contractions which include the right and left gastrocnemius medial head. in athletes when performing basic sepak sila techniques in the sepak takraw sport.

Research Subjects

The research subject is the place where the data for the research variables are obtained. The subjects in this research were athletes from the 2023 South Sulawesi sepak takraw sport, totalling 3 athletes. The characteristics used by the subjects in the research are athletes who have the best skills in each position (Tekong, Apit right/Feeder, and Apit left/Spiker), this is intended so that the subjects used in this research are truly in the best condition in terms of basic technique. sepak takraw.

Research sites

The research was carried out at the Sepaktaktaw Sports Building (GOR), Faculty of Sports Science, Makassar State University, Jl. Wijaya Kusuma Raya, No. 14, Makassar City. The research was carried out for 1 week, starting from 23 to 29 January 2023. The research time started at 14.00 WITA until finished.

Data Collection and Processing Techniques

Data Collection Techniques

The data collection technique in this research was carried out by recording and detecting EMG signals produced by athletes' muscle contractions using the Trigno™ Wireless EMG System. All data was obtained directly (primary data) with field measurement techniques carried out as follows:

1. First, the subject fills out the informed consent form.
2. Second, install the EMG sensor. The installation of the EMG sensor was carried out by a Sports Science Laboratory expert, where the electrodes or sensors were placed directly on the surface of the muscles that were contracting according to the movements made and then monitored. The muscle component that will be analyzed using EMG signals in this study is the gastrocnemius medial head muscle.

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3. Third, after installing electrodes on the gastrocnemius medial head muscle, the subject is prepared to take basic sepak sila technique measurements using basic sepak sila technique instruments.
4. Fourth, the measurement results are recorded thoroughly in an examination form saved into the Trigno™ Wireless EMG System software and then processed into a display that is easier to understand and interpret.

Figure 5.
Electrode placement on the medial head gastrocnemius muscle

Data Processing

Data analysis is the process of simplifying data into a form that is easier to interpret. Data processing is analyzed using a software analysis system that is available as part of the software of the Trigno™ Wireless EMG System tool. The output display is then processed into a display that is easier to understand, read and interpret. The data is in the form of EMG signal output and the total power value of the athlete's gastrocnemius medial head muscle which contracts when performing basic sepak sila technique movements.

Achievement Indicators

Performance indicators are final conditions or targets that are expected or achieved. Things that need to be done require consideration in determining performance indicators (not too high and not too low). The capabilities expected in this research include: (1) for trainers it can be used as evaluation material, where EMG signal measurements can be made. analyzing contracting muscles and detecting abnormalities in contracting muscles when carrying out certain movements, so that they can prepare and develop appropriate training programs for athletes. (2) for athletes, measuring EMG signals can determine the use of muscle groups that occur with each movement carried out so that it can provide an overview of effective and efficient movements.

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RESULTS AND DISCUSSION

Electromyogram (EMG) Results of Basic Sepak sila Techniques

First Subject

Briefly, the results of the EMG signal measurement of the basic sepak sila technique movements of the first subject are in Table 1, the RMS values in Table 4.2, and the results of the analysis of electromyogram (EMG) measurements for each muscle can be seen in graphic Figure 6.

Table 1.
Results of the first subject's foot EMG measurements.

R REF [mV]	L REF [mV]
0.01746	0.03944
0.09450	0.07520
0.14569	0.27997
0.14653	0.30582
0.44631	0.26487
0.11565	0.19554
0.19303	0.23616
0.11716	0.10205
0.14871	0.23616
0.21250	0.17842
0.23398	0.33520
0.02988	0.04952

Table 2.
Root Mean Square (RMS) EMG value of the first subject's foot.

RMS	
R GMH	L GMH
93.009	61.302

The results of measuring EMG signals for basic scrotal technique movements in Table 1 and the RMS values in Table 2 for the first subject are (1) the right gastrocnemius medial head, the largest 0.44631mV and the smallest -0.01746mV with an RMS value of 93.009, and (2) the left gastrocnemius medial head the largest 0.33520mV and the smallest 0.03944mV with an RMS value of 61.302.

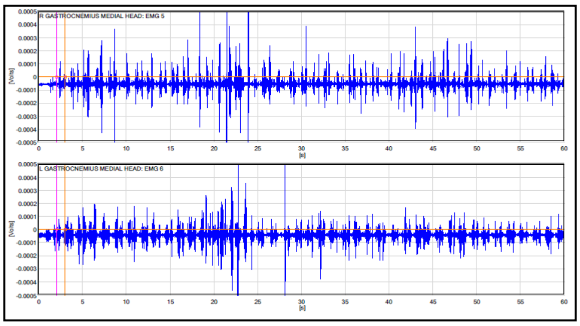

Figure 6.
Graph of electromyogram (EMG) Gastrocnemius Medial Head results for the first subject

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Second Subject

Briefly, the results of the EMG signal measurements for the basic sepak sila technique movements of the second subject are in Table 3, the RMS values in Table 4., and the results of the electromyogram (EMG) measurement analysis for each muscle can be seen in graphic Figure 7.

Table 3.
Results of the second subject's foot EMG measurements

R GMH [mV]	L GMH [mV]
0.36574	0.19219
0.49767	0.25866
1.37871	1.66238
0.38723	0.13831
0.38354	0.16550
0.19689	0.11783
-0.03055	-0.02350

Table 4.
Root Mean Square (RMS) EMG value of the second subject's foot

RMS	
R GMH	L GMH
38.7856	25.6827

The results of measuring EMG signals for basic scrotal technique movements in Table 3 and the RMS values in Table 4 for the second subject are (1) the right gastrocnemius medial head, the largest 1.37871mV and the smallest -0.03055mV with an RMS value of 25.6827, and (2) the left gastrocnemius medial head the largest 1.66238mV and the smallest -0.02350mV with an RMS value of 38.7856.

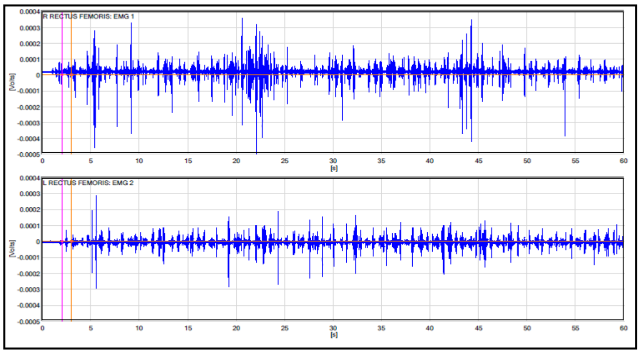

Figure 7.
Graph of electromyogram (EMG) Gastrocnemius Medial Head results for the second subject

Subject Three

Briefly, the results measurement of engineering movement EMG signals basics of the third subject in Table 5, RMS values in Table 6, and results electromyogram (EMG) measurement analysis for each muscle can be seen in Figure a. graph 8.

Table 5.
Results of the third subject's foot EMG measurements.

R GMH [mV]	L GMH [mV]
0.34241	0.21871
2.02191	0.19068
0.50053	0.30867
0.90101	0.30381
0.57958	0.37397
0.19823	0.18094
-0.05187	0.00504

Table 6.
Root Mean Square (RMS) EMG value of the third subject's foot.

RMS	
R GMH	L GMH
76.7969	47.3252

Results of EMG signal measurement of technical movements basic foot in Table 4.5 and RMS Value in Table 6 for the third subject is (1) right gastrocnemius medial head largest 2.02191mV and the smallest -0.05187mV with value RMS 76.7969, and (2) left medial gastrocnemius the largest head is 0.37397mV and the smallest 0.00504mV with an RMS value of 47.3252.

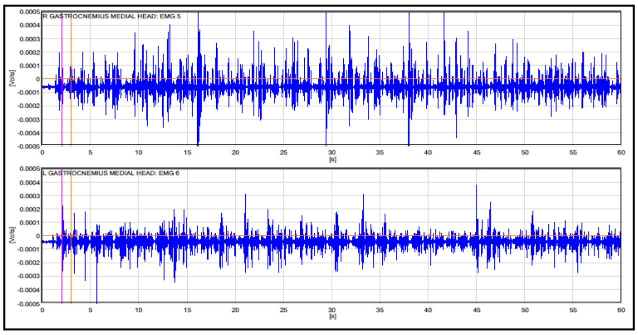

Figure 8.
Graph of electromyogram (EMG) Gastrocnemius Medial Head results for the third subject.

Discussion

The results of measuring the electromyogram (EMG) signal for each muscle measured, namely the right gastrocnemius medial head, and the left gastrocnemius medial head experienced fluctuations in movement according to the muscles that influence when performing basic sepak takraw technical movements. The results of the electromyogram (EMG) analysis of the resulting basic sepak sila technique movements experience movement fluctuations according to the muscles that influence muscle contraction.

Technically, when performing sepak sila movements, start with; a) standing with two feet shoulder-width apart. b) position of the sepak sila leg like a cross-legged person (bent).

c) both hands are opened and bent to maintain balance. d) the body is bent slightly. e) the supporting leg is slightly bent and f) the ball is kicked using the inside of the foot, this process is the most important thing in carrying out basic sepak sila techniques in the sport sepak takraw. Football is kicking the ball using the inside of the foot. Sepak sila is used to receive and control the ball, pass for smash attacks and save opponents' attacks. The stages of the basic sepak sila technique movement are a cycle of swinging the foot back and forth from bottom to top continuously in the phases of the stance and swing or kick. If the left foot is supported, the right foot functions as the kicking foot. When you are ready, stand with your legs shoulder-width apart. The distance between the body and the ball is approximately half an arm's length, so the body is closer to the ball because the hitter's leg is in a cross-legged (bent) position. Susnadi (2011) explains that the function of the sepak sila ball is to receive the smash immediately connect it direct it to the left or right flank, and finally provide feedback to the player in charge of attacking. In the analysis of sepak sila movements in the sepak takraw sport, the sepak sila sepak sila movements are supported by muscles that work in the lower limbs, namely both the upper and lower limbs. One of the muscle components that work in sepak sila movements is retroflexion movements, including the gluteus maximus, semimembranosus, gluteus medius, quadratus femoris, biceps femoris, semitendinosus, adductor magnus.

Based on the results of electromyogram (EMG) analysis, the 2 (two) muscle groups measured, namely the right gastrocnemius medial head and left gastrocnemius medial head for basic sepak sila technique movements of the three research subjects, produced different fluctuations in electromyogram (EMG) signals according to the condition of the muscles. Contracts when performing basic sepak sila techniques.

From the results of the electromyogram (EMG) analysis of basic sepak sila techniques, it can be stated that when the position is ready to perform basic sepak sila techniques, the electromyogram (EMG) signal frequency value is still stable and does not change, this is because the muscles have not contracted optimally. Changes in the shape of the electromyogram (EMG) signal frequency will occur and increase during movement so that at this stage the electromyogram (EMG) signal frequency increases to a certain value.

First Subject: The highest electromyogram (EMG) signal frequency measurement results occurred in the right gastrocnemius medial head muscle, where the results of the electromyogram (EMG) signal frequency in the right gastrocnemius medial head muscle were the largest 0.44631mV and the smallest - 0.01746mV with an RMS value of

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93.009mV, while the left gastrocnemius medial head muscle was the largest at 0.33520mV and the smallest at 0.03944mV with an RMS value of 61.302mV.

Second Subject: The highest electromyogram (EMG) signal frequency measurement results occurred in the right gastrocnemius medial head muscle, where the results of the electromyogram (EMG) signal frequency in the right gastrocnemius medial head muscle were the largest 1.37871mV and the smallest -0.03055mV with an RMS value of 25.6827mV, while the left gastrocnemius medial head muscle is the largest at 1.66238mV and the smallest at -0.02350mV with an RMS value of 38.7856mV.

Subject Three: The highest electromyogram (EMG) signal frequency measurement results occurred in the right gastrocnemius medial head muscle, where the results of the electromyogram (EMG) signal frequency in the right gastrocnemius medial head muscle were the largest 2.02191mV and the smallest -0.05187mV with an RMS value of 76.7969mV, while the left gastrocnemius medial head muscle was the largest at 0.37397mV and the smallest at 0.00504mV with an RMS value of 47.3252mV.

The results of calculating the EMG signal by looking at graphic images and tables of RMS values for the two muscle components measured in basic sepak sila technique movements resulted in the largest EMG signal occurring when the electrode was placed on the right gastrocnemius muscle, and the smallest contraction was on the left gastrocnemius muscle. This follows the characteristics of the gastrocnemius muscle running from the condyle lateralis femoris to merge with the calcaneus tendon and attach to the posterior surface of the calcaneus. The proximal attachment of the gastrocnemius muscle to the lateral head: lateral aspect of the lateral condyle (femur), medial head: facies popliteal femur, proximal to the medial condyle. The muscle stability movements that play a role are the tester fascia latae muscle, gastrocnemius muscle, anterior tibialis muscle and posterior tibialis muscle. Rogert (2010) explains that the gastrocnemius muscle functions to lift the heel and bend the knee. In basic sepak sila technique movements, the role of the left gastrocnemius functions when bending the knee, whereas in the right gastrocnemius, it contracts when swinging the sepak sila leg so that the role of the gastrocnemius produces a large EMG signal.

In conclusion, the results of this study show that there are differences in the use of muscle components in basic sepak sila techniques which result in EMG signal results being different from each other and the largest muscle EMG signal in the implementation of basic sepak sila techniques occurs in the gastrocnemius muscle component, namely in the right gastrocnemius medial head, whereas the smallest EMG signal occurs in the left

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gastrocnemius medial head muscle component. Thus, after knowing the EMG signal in each muscle component which is measured in basic sepak sila technique movements, it will provide information to the coach regarding the condition of the muscles that contract when performing basic sepak sila techniques in the sepak takraw sport, making it easier for trainers to prepare and develop appropriate training programs for athletes.

CONCLUSIONS AND SUGGESTIONS

Based on the results of data processing and the results of the analysis that has been carried out, it can be concluded as follows: The results of measuring muscle electromyogram signals when performing basic sepak sila technique movements in the sepak takraw sport produce the highest EMG signal strength occurring in the right gastrocnemius medial head, while the EMG signal is the smallest occurs in the muscle component of the left gastrocnemius medial head.

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