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The Effect of a Training Program for the Development of Anaerobic Muscle (Phosphagenic) Ability on the Electrical Activity of Twin Legs and Rectus Femoris Muscles in Football Pentathlon Under 23 Years of Age.

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ABSTRACT

This research included the **introduction and the importance of the research,** in which the researcher addressed the need to study and understand the changes that occur within the muscle fibers during physical exertion so that we can codify training programs for muscle strength on the correct scientific foundations, using modern devices and equipment such as the electromuscular angus (EMG) Bluetooth device to monitor the work of the muscles and that **the research problem** The lack of reliance of local training cadres lies in the use of modern devices, including the Bluetooth electromyography (EMG) device to monitor the work of muscles.**The purpose of the research** was to find out the changes in the electrical activity of the rectus femoris and twin muscles of the sac on the effect of a training curriculum to developanaerobic muscular ability.The research sample **consisted** of (20) trainees, and the researcher used **the experimental method** and the design of one experimental group with the pre- and post-tests, and the researcher used **the Sargent test (vertical jump from stability)** during the recording of electrical activity before and after the prepared training curriculum. By analyzing the results statistically, there was a change in the form and nature of electrical activity between the pre- and post-tests that can be used in developing and codifying programs and curricula for anaerobic muscular power training.

1- The first topic: Introducing the research.

1-1 Introduction and Importance of the Research:

All the developed countries in the field of sports have taken the lead in using the latest devices and technologies, and the advanced scientific programs available to them, and for this we see their athletes always on the podiums in most of the international sports forums, and this was the result of the use of these modern technologies and devices, and one of those many devices is the electromyography device (EMG) Bluetooth.

The importance of the research in the use of Bluetooth electromyography (EMG) is to monitor the resulting changes in muscle function and function and to consider the construction of various training programs accordingly.

1-2 Research Problem: The research problem is represented in the lack or lack of reliance of local training cadres in the use of modern devices, including the Bluetooth Electromuscular Electromyography (EMG) device to monitor the resulting changes in the work and functions of the muscles in order to build training programs in an accurate scientific manner.

1-3 Research Objective: To know the changes in electrical activity of the rectus femoris and tactus muscles following a training curriculum to developanaerobic muscular capacity.

.**1-4 Research Areas:**

1-4-1 Human Field: (20) trainees from the student teams of the Faculty of Pharmacy – Al-Mustansiriya University.

1-4-2 Temporal Domain: For the period from 10/10/2024 to 10/1/2025

1.4.3 Spatial Field: Baghdad / Fitness Hall of the Faculty of Pharmacy / Al-Mustasiriya University.

2- The second topic: the theoretical framework:

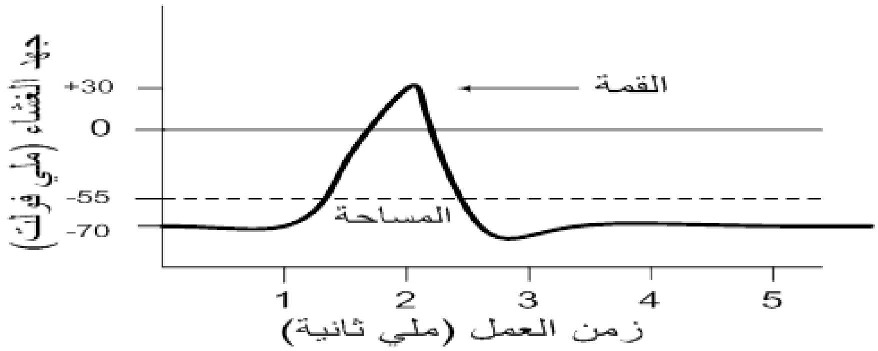
2-1 Electrical Activity of Muscles: The process of recording the electrical activity or electrical activity generated by the action of the muscles is known as electromyography (EMG), and (Brannon, 1975) pointed out that EMG is the process of recording the activity of a muscle, or it is an electrical activity associated with the muscle during its contraction (2:14).

The EMG method is based on recording the relationship between the work of both the nervous system and the muscular system, by recording the electrical changes that occur in the muscle during contraction, it is known that muscle contraction occurs as a result of a stimulation transmitted from the nervous system to the muscular system by the motor nerves, which in turn delivers the signal to the surface of the muscle, and then the potential difference occurs on both ends of the membrane as a result of the permeability in the membrane, and this change is represented in the amount of polarization (graphically) in the form of a trending line. This line returns to the normal level when the cell returns to its normal state, and thus the electrical activity diagram of the muscles is determined by two variables, one of which is represented by the x-axis and denoted by time in units (milliseconds) (msce).), and the other is represented by the Y-axis and symbolizes the signal strength in the unit (macro volts) (1:204), and through the curve recorded by the electromuscular (EMG) device, which is a device that has the ability to detect, record, and store a biological electrical signal that represents the electrical currents generated inside the muscle during its contraction, we can determine the effectiveness of the muscles through (5:11):

- **The vertical** indicator or curve height that indicates the amount of motor units involved in muscle contraction or units that respond to electrical stimulation.
- **A horizontal indicator** that indicates the time period of muscle contraction.

Through these two indicators, we can know the effectiveness or ability of the muscle to contract or respond to electrical stimulation, as the higher the curve and the less distance between the beginning and end of the curve, the more positive it is and vice versa.

The diagram below shows the electrical activity diagram of the muscles in general during muscle contraction.



2-2 The modern Bluetooth device for muscle planning: It is a device weighing no more than (390 g) **see Appendix No. (1)** that is tied around the player's waist by means of a belt, and this device sends Bluetooth signals about the activity of the muscles to be received by another device known as the receiver for a Bluetooth signal connected to a personal computer, and the device allows the player to perform all kinds of movements such as jumping, turning, running fast and counting (40) meters from the location of theThe signal will be accepted to be recorded and stored on the computer for later use (7:14).

The way the modern Bluetooth EMG device works involves the use of transducers known as electrodes (Elec-Rodcs) that determine the level of electrical activity of the muscles, and these electrodes are in the form of small discs made of conductive materials that are placed on the surface of the skin above the origin and fusion of the muscle to capture the electrical activity of the muscle, and after obtaining the electrical efficiency of the electrodes, they are inserted into the main part of the device for the purpose of magnification, analysis of charts, and calculation of results (8:36).

The EMG device is used clinically to determine the speed of electrical conduction in nerves and the extent of the muscular response to the diagnosis of neuromuscular system status, as Campbell (1989) and his colleagues indicated that the EMG signal is an important tool in diagnosing muscle electricalism, studying neuromuscular conduction, diagnosing peripheral nerve injuries, and studying the voltage generated within the muscle in order to diagnose sports injury (1:205).

2.3 Twin muscle:

It is one of the most important and superficial leg muscles in terms of location, as it arises with two heads that start from the thigh and are connected to the two lateral protrusions of the femur, and then extend to form the muscle that is visible in the leg from the back, and the distal end of this muscle fuses with the Achilles tendon, which is connected to the heel bone (83:10), and this muscle forms most of the fleshy mass in the upper posterior part of the leg, and it is a superficial muscle that covers the rest of the muscles of the region from the back and connects the femur to the heel bone (3:115).

This muscle bends the ankle joint and bends the knee joint when firmly fixing the foot on the ground, it is a strong muscle that has the ability to push the body strongly when walking and running and has the ability to contract suddenly and is necessary for jumping, and because it is a propulsive muscle, it has the ability to contract strongly and suddenly (6:279) and the twin muscle contributes effectively to the performance of most sports activities, so it is prone to muscle spasms, especially in stretching events or fast movements with changing directions, so it is one of the more The muscles of the body are affected by physical exertion and are sensitive to cases of muscle fatigue (562-563: 6).

What distinguishes this muscle **from the researcher's point of view** is that it works on two very important joints for most of the movements of the lower limb (legs), which are the knee and ankle joints, so most of the movements of these two joints are shared and contributed by this very important muscle for athletes in general and for football players in particular (11:189).

2-4 Rectus femoral muscle: This muscle is located in the anterior part of the thigh and is the middle of the quadriceps muscles and connects the pelvic bone to the tibial bone and has two tendons, the first arises from the lower anterior iliac spines of the ilium bone, and the other from the fossa above the upper edge of the acetabulum, and fuses with the first origin, and this muscle is fused in the upper edge of the patellar bone with the joint tendon of the quadriceps muscles, and fuses with the tibial tubercle of the tibia, it is the only muscle among the quadriceps muscles that work on the hip and knee joints. This muscle flexes the hip joint, stretches the knee joint, stabilizes and supports the pelvis and torso on the femur, and maintains an erection (6:191-192).

2-5 Anaerobic Ability: [(1:149)]

The term "anaerobic" refers to the muscular work that depends on the production of anaerobic energy, and since man cannot make any movement or even stay in a certain position without relying on muscle contraction, which therefore occurs only when the necessary energy is available to him, which is either anaerobic, i.e. without oxygen or aerobic energy in the presence of oxygen, so the physiological nature differs between the two types of energy production systems, when motor performance requires muscular work at maximum speed Or at maximum strength, the processes of directing oxygen to the working muscles cannot meet the need for rapid muscular action of energy, and on this basis energy is produced without oxygen, i.e. anaerobically.

There are two types of anaerobic energy production systems, one of which is the phosphate energy production system (ATP-PC), which is the fastest system responsible for producing energy for physical activities that are performed as fast as possible in no more than (30) seconds, and in the event that the duration of muscular work is increased to one or two minutes, the second anaerobic system, which is the lactic acid system (anaerobic glycation), becomes the system responsible for energy production, and this process produces lactic acid, which affects the ability of the muscle to continue in performance with the same intensity and fatigue occurs.

2 -6 Types of Anaerobic Abilities [(1:151)]

Anaerobic capacities are divided into two types:

- **Maximum Anaerobic Power :**

It is the ability to produce the maximum possible energy or work in the phosphogenic anaerobic system, and includes all physical activities that are performed at the maximum speed or strength and in the shortest possible time ranging between (5-10) seconds.

- **Anaerobic Capacity :**

It is the ability to maintain or repeat maximum muscle contractions depending on the production of anaerobic energy with the lactic acid system, and includes all physical activities performed with maximum possible muscle contractions, whether static or mobile, while facing fatigue up to one to two minutes.

3- The third topic: Research methodology and field procedures:

3-1 Research Methodology:

The researcher chose the experimental method and the design of one experimental group with pre- and post-tests in order to adapt this design to the research procedures.

3-2 Research Sample: The researcher selected a deliberate sample consisting of (20) trainees out of (80) i.e. (25%) of the original population, which are the athlete students who represent the teams of the Faculty of Pharmacy (Al-Mustansiriya University), and (5) of them were excluded for the purpose of the exploratory experiment, and the researcher took into account the homogeneity and parity of the sample members, as all the values of the torsion coefficient were between (1, -1), which means the homogeneity and parity of the sample through the following table:

Table (1)
Shows the homogeneity and equivalence of the research sample in the variables of height,

Torsion	Standard deviation	Broker	Arithmetic mean	Unit of Measurement	Variables
0.691-	4.121	176.500	175.229	Poison	Length
0.080	4.465	72.000	72.600	kg	Weight
0.078-	5.067	70.000	71.172	Z/D	Pulse (Comfort)
0.335	17.088	100.000	95.843	Z/D	Pulse (voltage)
0.005-	8.111	110.000	110.500	mm Hg	Systolic (rest)
0.391-	12.002	115.000	115.444	mm Hg	Z systolic (voltage)
0.081-	5.556	70.000	68.989	mm Hg	Z Diastolic (Comfort)
0.166	13.981	56.000	57.330	mm Hg	Z Diastolic (Voltage)

weight, pulse and blood pressure

3.3 Measurements under study: Measurements of electrical activity were taken by a Bluetooth EMG device for my muscles (rectus femoris and twin legs) during the Sargent **test (vertical jump from stability).**

The following were measured:

1. The highest level of electrical activity (apex or capacitance) of the rectus femoris and twin leg muscles during the performance of vertical jumping from stability.
2. Peak time of electrical activity (working time) of the rectus femoris and leg twins muscles during the performance of vertical jumping from stability.
3. The area under the curve of the rectus femoris and twin leg muscles during the performance of the vertical jump from stability and is calculated by the product of multiplication **(peak × its time).**

3.4 Field Research Procedures:

3-4-1 Exploratory Experiment: On 10/10/2021, the researcher and the assistant team conducted the exploratory experiment using a Bluetooth (EMG) device on (5) trainees (who were later excluded) while performing the vertical jump test from stability to prepare for a better picture of the first main experiment, which is the pre-test.

3-4-2 Pre-Test: On 12/10/2021, the researcher and the assistant team conducted the pre-test on the experimental group, and the results were recorded by computer and stored to be entered into the appropriate statistical treatments and later compared with the results of the post-test.

3-4-3 Training Curriculum: On 17/10/2021, the researcher started implementing the training curriculum prepared for the experimental group, which lasted for (8) weeks, with (3) training units per week and a total of (24) training units, and the training curriculum ended on Tuesday, 6/1 / 2022 **, see Appendix (2).**

3.4.4 Exercises under Study: The training module included the following exercises: (Set-up exercise**, machine** push-up exercise with finger push, triceps finger legs inward and outward exercise, curl legs exercise, exercise, backarc **see Appendix (3).**

3-4-5 Post-test: On 10/1/2022, the researcher and the assistant team conducted the post-test on the experimental group, and the results were recorded by computer and stored to be entered into the appropriate statistical treatments and compared with the results of the pre-test.

3-5 Statistical Methods: The arithmetic mean, standard deviation, and (T-test) were used for the symmetrical samples, which **allowed the researcher** to reach the results and the relationships envisaged from the research.

4- Fourth Topic: Presentation, Analysis and Discussion of the Results:

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Presentation, analysis, and discussion of the results of the experimental group's pre- and post-tests in the electrical activity (EMG) variables of the rectus femoris muscle.

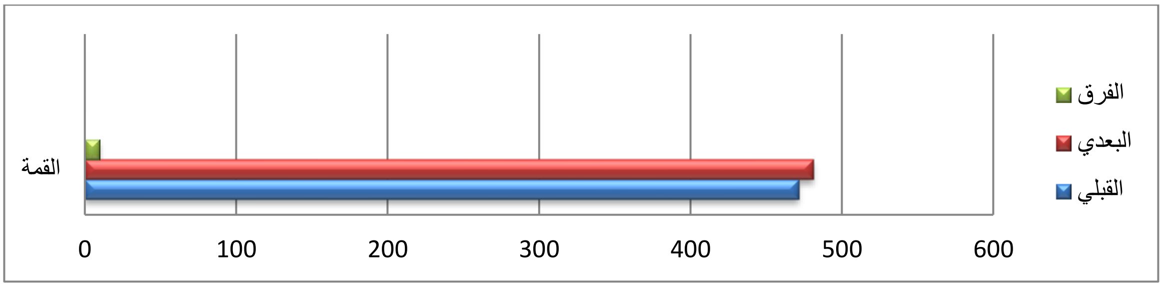
Table (2)
Shows the experimental group's mean of electrical activity (EMG) variables of the rectus femoris muscle in the pre and post-tests

Experimental Group		Unit of Measurement	Variables
Q Dimension	Q Qibli		
481.576	471.746	Micro Volt	Top
176.815	174.176	Micro Volts. Tha	Area
0.35466	0.4755	Second	Working Time

Table (3)
Shows the mean differences and their standard deviations, the value of (t) and the significance of the differences between the results of the pre- and post-tests of the experimental group in the electrical activity variables (EMG) of the rectus femoris muscle

Significance of the differences	T-value Calculated	H2F	M.F.	Unit of Measurement	Variables
Willy-nilly	0.1668	976841.24	13.2	Micro Volt	Top
Willy-nilly	1.274	45134.65	21.67	Micro Volts. Tha	Area
Moral	7.96	0.0985	0.199	Second	Working Time

Figure (1)
Illustrates the arithmetic averages in the pre- and post-tests and the difference between them for the apex variable of the rectus femoris muscle

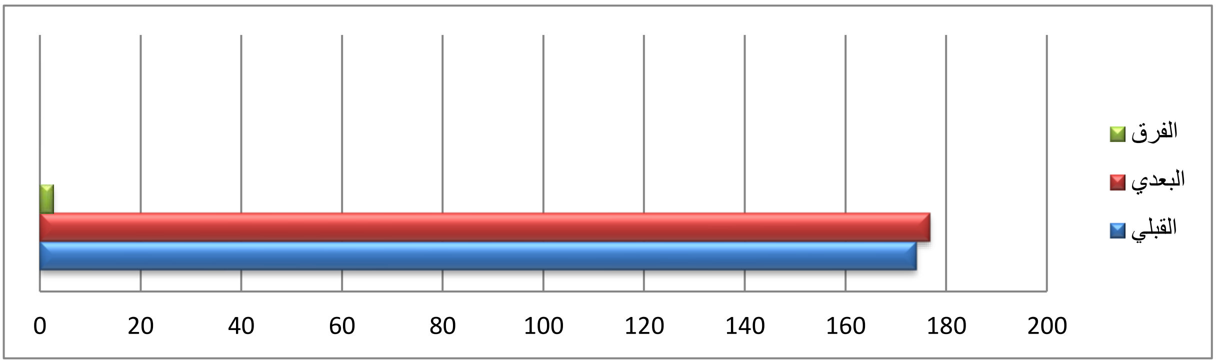


From Table (2) and Graph (1) and in the top variable, we can see that there are differences in the arithmetic circles between the pre- and post-tests in favor of the post-test, and from Table (3) we can see that the calculated value of (t) (**0.1668**) at the level of significance (0.05) and the degree of freedom (12) which is less than the tabular value of (1.771), so the significance of the differences is random with the observation of the differences. In the arithmetic median between the pre- and post-tests in Table (2), and Graph (1).

The researcher attributes the difference in the peak variable (increase in numerical value) in the post-test to the various resistance exercises prepared by the researcher, according to which the ability of the target muscles under study to be subjected to electrical stimulation andto recruit a greater number of motor units and in less time was developed, and this development was manifested during the performance of the vertical jump test of stability, and this development appeared in the form of an increase in the height of the peak in the electromyography curve

Figure (2)

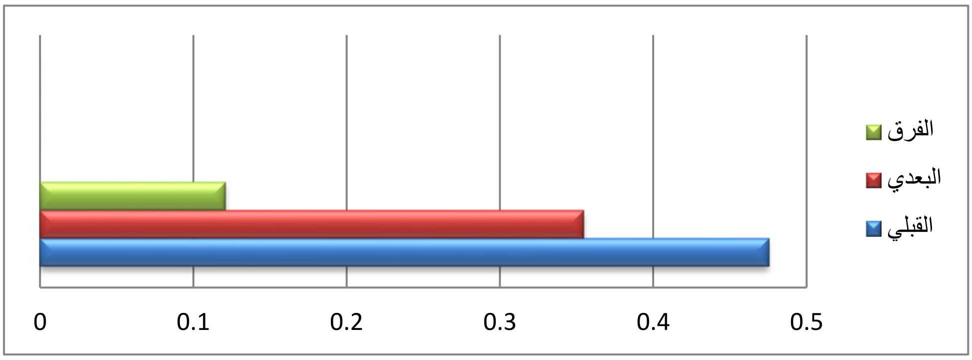
Illustrates the arithmetic medians in the pre- and post-tests and the difference between them for the area variable of the rectus femoris muscle



From Table (2) and Graph (2) and in the area variable, we can see that there are differences in the arithmetic circles between the pre- and post-tests in favor of the post-test, and from Table (3) we note that the calculated value of (t) (**1.274**) at the level of significance (0.05) and the degree of freedom (12) which is less than the tabular value of (1.771), so the significance of the differences is random while noting the differences. In the arithmetic circles between the pre- and post-tests in Table (2), and the graph (2).

The researcher attributes this development in the area variable in the post-test (numerical value) to the various resistance exercises prepared by the researcher, which helped to increase the electrical stimulation of the working muscles, which led to a significant increase in the number of motor units involved in muscle contraction, and this is what the variable (peak) represents, and since **the area = the peak × the working** time. , the increase in the value of the (top) with a slight decrease in the working time led to this increase in the area variable, which is positive.

Figure (3) shows the arithmetic mean in the pre- and post-tests and the difference betweenthem for the variable of working time of the rectus femoris muscle



From Table (2) and Graph (3) and the working time variable, we can see that there are differences in the arithmetic circles between the pre- and post-tests in favor of the post-test, and from Table (3) we note that the calculated value of (t) (**7.96**) at the level of significance (0.05) and the degree of freedom (12) is greater than the tabular value of (1.771), so the significance of the differences is significant as shown in Table (2).), and Figure (3).

The researcher attributes this development in the muscle work time variable in the post-test to the various resistance exercises prepared by the researcher, which developed the explosive power of the muscles under study, and in turn led to an increase in the speed of muscle contraction, i.e., a reduction in the working time, which is a positive indicator, and this development began to manifest in the electromyography curve of the muscles in the form of narrowing the horizontal distance between the beginning and end of the curve wave.

Presentation, analysis, and discussion of the results of the experimental group's pre- and post-tests in the electrical activity (EMG) variables of the twin muscle.

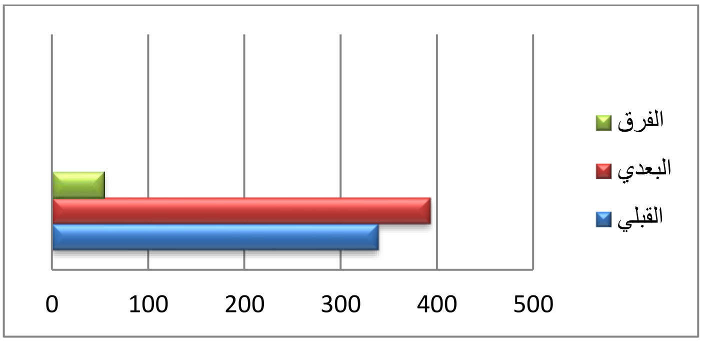
Table (4)
Shows the arithmetic median of the experimental group in the electrical activity (EMG) variables of the twin muscle in the pre- and post-tests

Experimental Group		Unit of Measurement	Variables
Q Dimension	Q Qibli		
393.4692	339.2307	Micro Volt	Top
111.938	111.961	Micro Volts. Tha	Area
0.3682	0.4055	Second	Working Time

Table (5)
Shows the mean differences and their standard deviations, the value of (t) and the significance of the differences between the results of the pre- and post-tests of the experimental group in the electrical activity (EMG) variables of the twin muscle

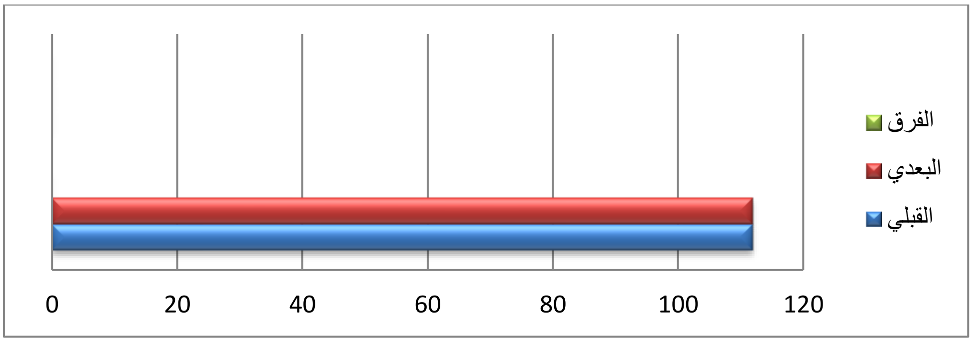
Significance of the differences	T-value Calculated	H2F	M.F.	Unit of Measurement	Variables
Willy-nilly	1.108	273829.14	46,45	Micro Volt	Top
Willy-nilly	0.183	25061.892	- 2.33	Micro Volts. Tha	Area
Moral	1.966	0.1421	0.059	Second	Working Time

Figure (4)
Illustrates the arithmetic mean in the pre- and post-tests and the difference between them for the apex variable of the twin muscle



From Table (4) and Figure (4) and in the apex variable of the twin muscle, we can see that there are differences in the arithmetic circles between the pre- and post-tests in favor of the post-test, and from Table (5) we can see that the calculated value of (t) (**1.108**) at the level of significance (0.05) and the degree of freedom (12) is less than the tabular value of (1.771), so the significance of the differences is random with the observation of the differences in the arithmetic circles between the pre- and post-tests in Table (4).), and Figure (4).

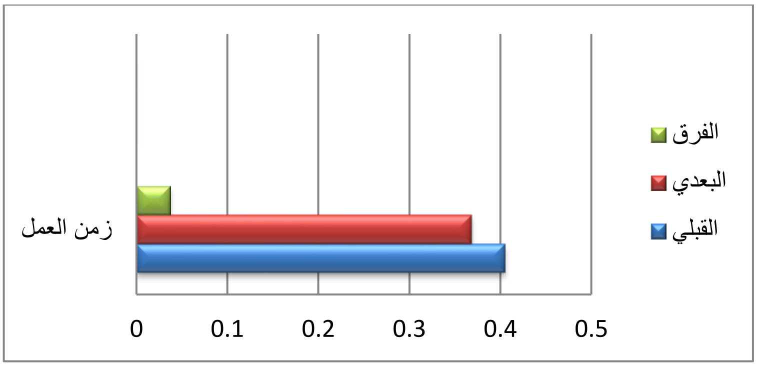
Figure (5)
Illustrates the arithmetic mean in the pre- and post-tests and the difference between them for the area variable of the twin muscle



From Table (4) and Graph (5) and in the area variable of the twin muscle, we can see that there are differences in the arithmetic between the pre- and post-tests in favor of the post-test, and from

Table (5) we note that the calculated value of (t) (**0.183**) at the level of significance (0.05) and the degree of freedom (12) is less than the tabular value of (1.771), so the significance of the differences is random with the observation of the differences in the arithmetic circles between the pre- and post-tests in Table (4).), and Figure (5).

Figure (6)
Illustrates the arithmetic medians in the pre- and post-tests and the difference between the two mediums of the working time variable of the twin muscle



From Table (4) and Figure (6) and the variable of the working time of the twin muscle, we can see that there are differences in the arithmetic between the pre- and post-tests in favor of the post-test, and from Table (5) we can see that the calculated value of (t) (**1.966**) at the level of significance (0.05) and the degree of freedom (12) is greater than the tabular value of (1.771), so the significance of the differences is significant as shown in Table (4), and the graph (6).

The researcher believes that this development in the arithmetic circles between the pre- and post-tests in the working time variable of the twin muscle is due to the same reasons in the previous two discussions.

- Fifth Topic: Conclusions and Recommendations:

5-1 Conclusions: By presenting, analyzing and discussing the results, the researcher concluded the following:

1. Monitoring the functional development of the muscles before, during and after the training programs with the mediated electromyography (EMG) Bluetooth device is very important in understanding these developments.

2. It is possible to build and codify exercises, curricula, and training programs related to muscles with the help of Bluetooth electromyography (EMG).

5.2 Recommendations:

The researcher recommends the following:

1. The necessity of using Bluetooth electromyography (EMG) device to monitor muscle functional developments before, during, and after training programs.

2. Building and codifying exercises, curricula, and training programs related to muscles using Bluetooth electromyography (EMG).

3. Conducting further research using Bluetooth electromyography (EMG) in various muscular strength training and on various muscles.

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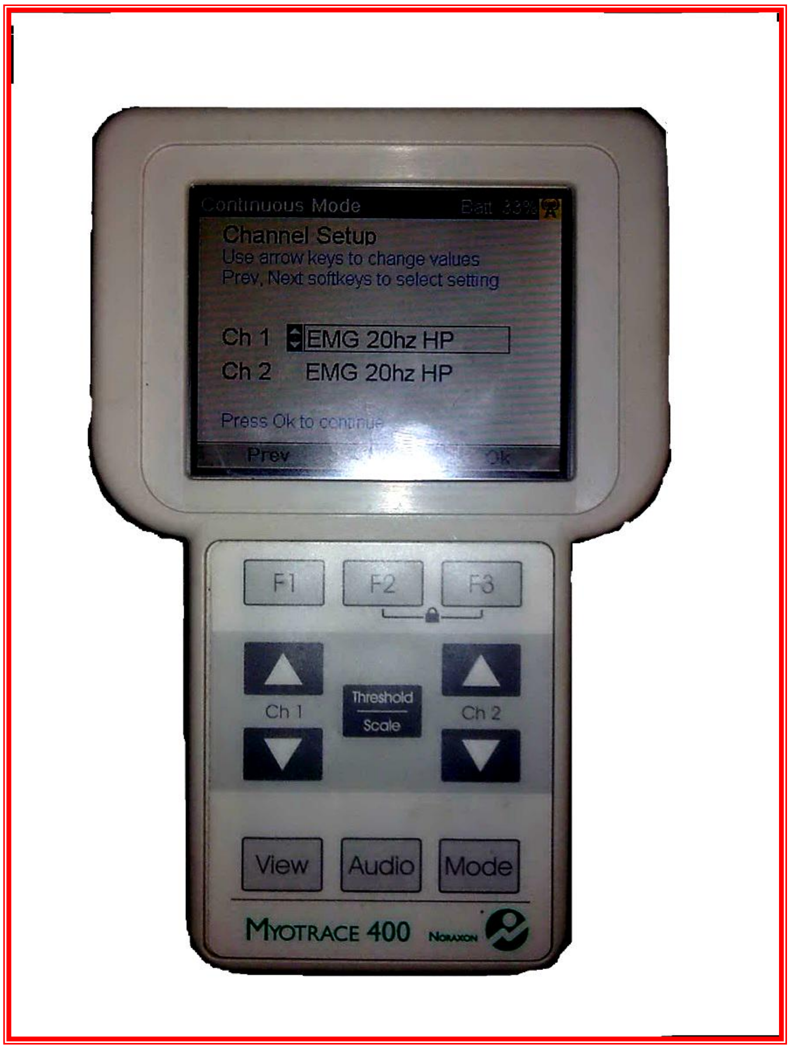
Appendix (1)

Modern Bluetooth Device (EMG) for Muscle Planning



Appendix (2)
Training Curriculum

Stress Training	Dating	Today	Training Module Sequence
30%	17/10/2021	Sunday	First Training Module
30%	20/10/2021	Wednesday	Second Training Module
35%	24/10/2021	Sunday	Third Training Module
35%	27/10/2021	Wednesday	Fourth Training Module
40%	31/10/2021	Sunday	Fifth Training Module
40%	3/11/2021	Wednesday	Sixth Training Module
45%	7/11/2021	Sunday	Seventh Training Module
45%	10/11/2021	Wednesday	Eighth Training Module
45%	14/11/2021	Sunday	Ninth Training Module
50%	17/11/2021	Wednesday	Tenth Training Module
50%	21/11/2021	Sunday	Eleventh Training Module
50%	24/11/2021	Wednesday	Twelfth Training Module
55%	28/11/2021	Sunday	Thirteenth Training Module
55%	1/12/2021	Wednesday	Fourteenth Training Module
55%	5/12/2021	Sunday	Fifteenth Training Module
60%	8/12/2021	Wednesday	Sixteenth Training Module
60%	12/12/2021	Sunday	Seventeenth Training Module
60%	15/12/2021	Wednesday	Eighteenth Training Module
65%	19/12/2021	Sunday	Nineteenth Training Module
65%	22/12/2021	Wednesday	Twentieth Training Module
70%	26/12/2021	Sunday	Twenty-first Training Module
70%	29/12/2021	Wednesday	Twenty-second Training Module
75%	3/1/2022	Monday	Twenty-third Training Module
75%	6/1/2022	Thursday	Twenty-fourth Training Module

Appendix (3)
Phosphogenic Ability Development Exercises

Target Muscles	Objective	Comfort	Size	Hardship	Exercise Name	Sequence

Quadriceps (lateral dilatus)	Capacity Development	30-60 seconds	3×10 10-12 S	40-75%	Triceps legs (fingers out)	1
Quadriceps (dilatase media)	Capacity Development	30-60 seconds	3×10 10-12 S	40-75%	Triceps legs (fingers inwards)	2
Rectus spines and gluteal muscles	Capacity Development	30-60 seconds	3×10 10-12 S	Body weight with a gradient increase for extra weight	Back-Arch	3
Rectus abdominis (especially the upper body)	Capacity Development	30-60 seconds	3×10 10-12 S	Body weight with a gradual increase in the stalag of the mastaba	Water Set	4
Twins and hamstring muscle	Capacity Development	30-60 seconds	3×10 10-12 S	40-75%	Curl Legs	5
Twins and plantar	Capacity Development	30-60 seconds	4×10 10-12 S	40-75%	Push Machine with Finger Push	6

Notes on Exercise:

Through the **researcher's** modest experience in teaching and coaching football, fitness, personal interviews with expert professors, and access to modern sources**, the researcher has** identified the following:

1- The duration of the exercises is set at (12) weeks and twice a week, and the intensity, training volumes, and rest periods indicated in the curriculum model are ascending with the completion of each week of (40-75 %) of the maximum intensity of each exercise, while the first and second weeks are determined for the purposes of preparation and preparation at (30-35 %) of the maximum intensity of each exercise, respectively.

2- Flexibility, stretching, and relaxation exercises are performed after the end of the exercise in question for a period of (5) minutes to remove the tension and strain that may be caused by the exercises.

3- **In his training curriculum, the researcher used** the repetitive training method as well as the low- and high-intensity interval training method in some exercises.

4- Rest intervals between repetitions were limited to (30-60) seconds, and between combinations of (2-3) minutes

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