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A MECHANICAL INTERPRETATION OF THE ELECTRICAL ACTIVITY OF THE WORKING MUSCLES AS A FUNCTION OF PREDICTING THE PERFORMANCE OF THE CRUCIATE FULCRUM SKILL ON THE THROAT APPARATUS IN ARTISTIC GYMNASTICS FOR MEN

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Abstract:
The mechanical explanation of the bioelectrical activity of the elements of the cruciate support skill on the throat apparatus in men's gymnastics has not been widely understood in scientific research to date. Given the increasing challenge of implementing experimental protocols and collecting data from multiple individuals, it is necessary to develop strategies that allow for safe, valid, and reproducible methodology.
The research problem can be summarized with the following question: Is it possible to obtain numerical values through mechanical analysis of the muscles working during the main stage of performance (balance) through which this can determine the most important strengths and weaknesses that accompany performance and how to benefit from it and develop solutions to weak points and evaluate and benefit from them? Strengths and their relationship to the force produced by the major muscles during the major phase in terms of electrical activity, bearing in mind that gymnastics offers almost limitless possibilities for studying human movement. Researchers should focus on the type of item, degree of difficulty, and key characteristics. The relationship between the device and the specifics of the device specifications and safety conditions. The axis of the joint represents the fulcrum of the crane. The force of muscle contraction represents force and body weight represents resistance. The research aimed to identify the electrical activity of the working muscles during the main stage of performing the cruciate anchor skill on the throat apparatus in gymnastics for men. The researcher hypothesized that there would be a positive effect of the mechanical interpretation of the electrical activity of the working muscles as a function of predicting the performance of the anchor skill. The cruciate on the throat apparatus in artistic gymnastics for men. The research aimed to identify the effect of mechanical interpretation of the electrical activity of the working muscles as a function of predicting the performance of the skill of the cruciate fulcrum on the throat apparatus in artistic gymnastics for men. The researcher used the descriptive approach as it is the most appropriate method for the nature of the research problem. The researcher chose a combined Originally, they were players from the national teams of the Middle Euphrates governorates. The research sample was chosen intentionally, consisting of 10 players. The player made one attempt at the skill study, and the primary muscles on the right side of the player were measured on the throat device. It is considered a model of strength skills in men's gymnastics, and one must hold still for at least two seconds in competition. As an example of approximating the shoulder joints and performing skills that require the use of the same muscles responsible for adducting the shoulder joints, the skill of cruciate support on the throat apparatus in gymnastics for men was chosen. Five main working muscles were selected for

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this skill and to identify the percentage of their contribution during the performance of the study skill as well. The hypothesis was achieved by constructing a predictive equation that can be used in evaluating performance. The results indicated that the teres major muscle came in first place, the teres major muscle came in second place, and the pectoralis major muscle came in third place, and the latissimus dorsi muscle came in fourth place, in percentage. Then the triceps brachii (long head) came in last place in percentage.

Then the triceps brachii (long head) came in last place in percentage. The mechanical analysis of the working muscle points for skill performance and achieving the principle of balance is considered one of the important points that have not been given a large share by researchers due to the difficulty of providing modern equipment and modern laboratories and the high financial cost through the process of linking the sciences to find out the mechanism and nature of those sciences and the nature of values. The digital one gives us accurate numerical values for the nature of the work of all the muscles involved in performance and the percentage of each one of them, in addition to the nature of the mechanical contraction associated with it.

Keywords: EMG Device, Throat Device, Regression Equation, Cruciate Fulcrum, SPSS Statistical Bag.

Introduction

As a result of the technological progress that has invaded various fields of human knowledge, sports activity has received a large share of progress and development, with world championships and the Olympic Games becoming a stage in which sports champions display their prowess by demonstrating the results they have achieved. Among the new movement innovations in the arts of movement performance, the research process took a form, structure, and organization consistent with the state of new development of the methods, methods, and means used. Scientific development has added many new and modern methods that are compatible with the nature and capabilities of players through the efforts of coaches to choose the best and latest methods that are appropriate for the specialized activity. Accordingly, scientific research has tended towards studying various sciences, including biomechanics, and employing them to raise the level of athletes in all fields. Sports games because these sciences are of fundamental importance in developing and evaluating training methods. And knowing the responses and adaptations that occur during sports activity, to reach the desired level.

Gymnastics is characterized by the multiplicity of its equipment and its different geometric designs, and thus the diversity of motor skills that each of them performs. There is a huge amount of skills that each device performs, reaching the level of technical knowledge of performance. Each skill represents a level of difficulty for gymnastics trainers. Modern scientific devices, especially the EMG device and its programs, have been used to measure and analyze the electrical activity of the muscle. The device records and analyzes the electrical activity of the skeletal muscles. It is important for many sports because they need a neuromuscular device to evaluate the safety and speed of the transmission of nerve signals from the muscles, in addition to knowing and estimating the motor units operating in the skeletal muscles. It is the one that studies,

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photographs and records the frequency and range during muscle contraction. [1]

The importance of the research comes in knowing the electrical activity of the muscles working during the main stages in performing the skill of angular support on the throat apparatus in artistic gymnastics and knowing the electrical activity of the main muscles that work in these skills as a descriptive study in this field, and that the relationship between correct technical performance and its various physical requirements is close. It must be taken into consideration when preparing players, and one of the most important basic technical skills in performance is balance, which is considered one of the critical skills for performance results, and this skill is linked to the strengths of the working muscles.

Gymnastics is characterized by the multiplicity of its equipment and its different geometric designs, and thus the diversity of the motor skills that each of them performs.

There are a huge number of skills that are performed on each apparatus that reach the degree of technical knowledge of performance. Each skill represents a level of difficulty based on the recent amendments to the men's artistic gymnastics points code by the International Gymnastics Federation. The ring device consists of five groups: (pronation and swing elements, handstand swing elements, grip strength swing elements, and strength and stability elements). This work aims to collect information and systematic analysis of the biomechanical approach to the skill of the cruciate support on the throat device in men's gymnastics. The importance of the research lies in knowing the electrical activity of the muscles working during the main stages of performance, and the skill of the cruciate support on the throat device in men's gymnastics.

The importance of the research comes in knowing the electrical activity of the muscles working during the main stage of performing the cruciate support skill on the throat apparatus in gymnastics for men, which works in these skills as a descriptive study in this field. The hypothesis was also achieved through the predictive equation that can be used in evaluating performance.

3 - Research Methodology and Field Procedures:

3-1 Research Methodology:

Choosing the appropriate method is one of the necessities of scientific research. Scientific research methods have varied, as the choice of research method must be appropriate to the research problem and how to reach a solution to the problem .In addition, the nature of the phenomenon that the researcher addresses are what determines the type of method used and its objectives. Therefore, the researcher used the descriptive method because it is compatible with the nature of the research problem.

3-2 The Research Community and The Research Sample:

The research community means all the components of the phenomenon that the researcher studies, that is, all the individuals, people, or things who are the subject of the research problem[2]. To achieve the objectives of the study, the researcher identified the research community, which is the players applying for the Middle Euphrates teams, which fall under the auspices of the sub-gymnastics federations in Diwaniyah Governorate, who number (11) players. One player was

[1] Wajih Mahjoub: Kinetic Analysis, 1st edition, Higher Education Press, Baghdad, 1987, p. 204.

[2] Wajih Mahjoub (and others): Scientific research methods and curricula in physical education, Baghdad, Higher Education and Scientific Research Press, 1988, p. 261.

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excluded to benefit from him in the exploratory experiment so that the number of the research sample became 10 players using the intentional method.

3-3 Means of Collecting Information:

1- Arab and foreign sources
2- For observation, experimentation and personal interviews.
3- For tests and measurement.
4- Devices and tools used in the research:
5- An Italian-made system for measuring electrical muscle activity (EMG).
6- Sports Movement Analysis Program (KINOVA)
7- Surface sensors.
8- Myo Research XP 1.06.67 program.
9- A computer.
10- Video camera type (CASIO), model (Exilim), Japanese-made, with a frequency speed of 300 images/second, number…(1)
11- Legal throat device(1)
12- Ground movements mat.

3-4 Identify the Muscles Involved in Motor Skills

The researcher chose the skill of cruciate support on the throat apparatus because it is considered a model of strength skills in men's gymnastics and must be held for at least two seconds in competition, and an example of rounding the shoulder joints. Performing the skill requires the use of the same muscles responsible for rounding the shoulder joints. Hence, the researcher identified the main muscles responsible for rounding the shoulder joints, which were represented in the following muscles:

1- Biceps (short head)
2- The pectoralis major muscle
3- Latissimus dorsi muscle.
4- The large teres muscle.
5- Triceps muscle (long head).

3-5 Exploratory Experience

The exploratory experiment is a preliminary experimental study aimed at choosing research methods and tools, to determine the level of devices used and selecting them, as well as knowing the negative aspects that the work will face.

The exploratory experiment is "a practical method for uncovering the obstacles that the researcher may face while carrying out the main experiment and preparing in advance the requirements of the experiment in terms of time, cost, auxiliary personnel, devices, tools, etc.

The exploratory experiment was conducted on (Thursday) (5/24/2022) at (10) am in the closed gymnastics hall at the College of Physical Education and Sports Sciences, Al-Qadisiya University, for the purpose of measuring the electrical activity of the following muscles:

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1- Biceps (short head)
2- The pectoralis major muscle
3- Latissimus dorsi muscle.
4- Teres major muscle.
5- Triceps muscle (long head).

The experiment was conducted on one player outside the research sample from the same stage to determine the location of the sensors on the working muscles and to determine the location of the device that receives the Bluetooth signal from the electromyography (EMG) device. The aim of the exploratory experiment was to ensure the safety of the telescoping device and to become familiar with the organization and sequence of tests and measurements, as well as to identify the difficulties and the testers' understanding of the research tests. The results were as follows:

1- The ability of the system (EMG) to accurately and appropriately measure the electrical activity of the muscles of the foot opposite the rising phase through performance.
2- The stability time of 2 seconds was appropriate and accurate.
3- Five muscles were chosen, on the right side, due to the small number of electrodes available in the device and the damage of some due to repeated use. Only the right side was measured, and experts were consulted that the right side was expressive or similar to the left side in exerting force.

3-6 EMG System:

An MR3 device produced by Noraxon was used to record the electrical activity of skeletal muscles with eight electrodes (8 channels) using the application software version (3.16.68).It is one of the latest portable laboratory technologies, through which the electrical activity of eight muscles can be examined and recorded simultaneously, via Bluetooth signals, up to 20 meters away from the computer. After determining the muscles targeted for work through the specialist for this purpose, namely: (anterior gastrocnemius, anterior gastrocnemius, posterior lateral gastrocnemius, posterior lateral gastrocnemius). There are several steps to prepare the measurement to work with the EMG device, which are:

1- Before opening the EMG program, the hair was removed from the area of the muscle and then cleaned with sterile materials. Here, we must emphasize the importance of cleaning the area to remove dead skin or a light layer of keratinized skin that affects the electrical signal.
2- Place surface electrodes to record electrical activity. The electrode closest to the stimulated motor unit will record a larger EMG signal and a smaller signal if the stimulated motor unit is far from the detector. The surface sensor is the most widely used in analyzing human movements, in addition to recording the signals that pass under the surface of the surface sensor, it also records electrical signals. The surface detector consists of a small metal disk with a diameter of 1 cm. The detector is made of silver chloride and has a high sensitivity to the electrical signal issued by the muscles close to the skin. These sensors record the signal that indicates the rate of electrical activity. The function of the surface sensors, which will be attached to the middle of the muscle, is to detect the electrical current in the activated muscles and transfer it to the computer screen to show the strength of the signal. It analyzes the stored data and provides useful

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reports on muscle activity. These sensors are then connected by electrical wires to the EMG device.

Figure (1) Shows Placing and Installing the Detector Before Starting the Test

3- Open the EMG program on the computer (Lap Top) and select the muscle that we want to study electrically through the anterior or posterior anatomical section of the human body.

4- Then we connect the camera to the computer, open the Bluetooth signal, and then give instructions to the player to perform the skill, so the signal appears with the image on the computer.

5- After completing the skill, the results appear on EXEL.

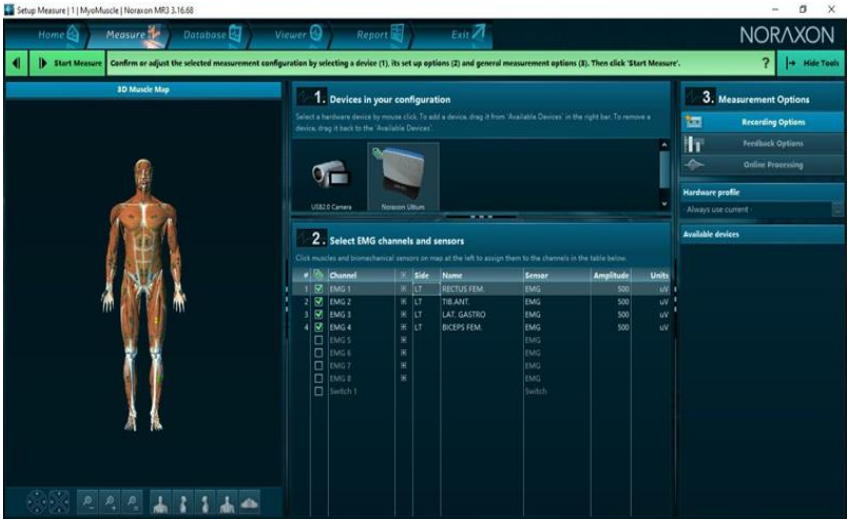

Figure No. (2) Shows the Main Page of the Device Interface

3-7 Skill Performance Test

Performance specifications: The cruciate pivot is one of the most difficult ring movements because it requires great flexibility of the shoulder joint and high strength so that the player can achieve stability (balance). Therefore, the gymnast must need a special strength training program in addition to specific strength.

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3-7-1 Technical Aspects:

- The player's throat and shoulders are in one line
- Straightening the arms and torso
- The muscular load should fall on the muscles of the arms and shoulder girdle
- The head is in its natural position, looking forward

3-7-2 Purpose of the Test :-

A. Measuring the values and variables of the EMG system

B. - Correct skill performance

During the 2-second stability phase, the device's sensors are connected to the player's muscles according to each studied variable and are synchronized with a phase to measure mechanical variables, electrical activity, and productive force. A legal earring device is used, and a video camera is used with 300 images/second (1 number).

Figure No. (3) shows the skill of the individuals in the research sample

3-8 Main Experiment

The main experiment was carried out in the gymnastics hall at the College of Physical Education and Sports Sciences, Al-Qadisiya University, on Sunday (5/27/2022).With the help of the work team, using a device to measure the main electromyography while performing the cruciate support skill on the throat device, the researcher used surface electrodes installed over the studied muscle, where the player made one attempt, and the primary muscles on the right side of the player were measured. Due to the small number of electrodes in the device available and some being damaged due to repeated use, only the right part was measured and experts were consulted that the right side is expressive or similar to the left side in terms of exerting force. After completing the performance, the data was transferred to an Excel file and used to interpret the results of the experiment.

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3-9 Statistical Methods Used In The Research[3] :

1- Arithmetic Mean.
2- The Mediator.
3- Standard Deviation.
4- Torsion Coefficient.
5− Percentage.

4-1 Statistical Description of The Distributions of Research Variables for The Model Building Sample:

Table (1) Arithmetic Means, Standard Deviations, And Standard Error for The Research Sample in The Investigated Variables

Variables	Arithmetic Mean	Standard Deviation	Standard Error
Triceps muscle	729.300	73.092	23.114
Pectoralis major muscle	536.100	49.140	15.540
Racine brachii muscle	360.400	36.594	11.572
Latissimus dorsi muscle.	628.300	58.519	18.505
Teres major muscle	829.000	54.072	17.099
Skill evaluation	8.650	0.818	0.259

Table (1) shows that the arithmetic mean for the variable (three-headed muscle) was (729.300), with a standard deviation of (73.092) and a standard error of (23.114). As for the arithmetic mean for the variable (pectoralis major muscle), it was (536.100). With a standard deviation of (49.140) and a standard error of (15.540), As for the arithmetic mean of the variable (muscle A, biceps brachii), it came in at (360.400), with a standard deviation of (36.594) and a standard error of (11.572). As for the arithmetic mean for the variable (Latissimus dorsi muscle), it came in at (628.300), with a standard deviation of (58.519) and a standard error of (18.505). As for the arithmetic mean for the variable (teres major muscle), it was (829.000), with a standard deviation of (54.072) and a standard error of (17.099). As for the arithmetic mean of the variable (skill evaluation), it came in at (8.650), with a standard deviation of (0.818) and a standard error of (0.259).

4-2 Finding the Correlation Between the Variables Under Study for The Research Sample:

Table (2) Shows the Correlations Between the Study Variables

Variables	nature of correlation,	correlation coefficient		statistical significance
		Calculated	Moral level	
Teres major muscle	basic	779.0	0.008	Moral
biceps	basic	0.805	0.005	Moral
Dorsal muscle	basic	0.422-	0.225	Insignificant
Pectoral muscle	basic	0.708	0.022	Moral
Triceps muscle	basic	0.080-	0.825	Insignificant

[3]1)) Muhammad Jassim Al-Yasiri: Principles of Educational Statistics, An Introduction to Descriptive and Inferential Statistics, 1st edition, Amman, Dar Al-Safaa for Publishing and Distribution, 2018.

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When reviewing the results of Table (2), we find that the values of the correlation coefficient between the variable (performance evaluation of skill) and the muscle strength variables reached, respectively, (0.837, 0.805, -0.422, 0.477, -0.480). The value of the significance level accompanying it, which came in a row (0.000, 0.000, 0.000, 0.000, 0.000), all of which are greater than (0.025), which indicates that the correlation is significant and the relationship is real, and that it did not occur as a result of chance.

4-3 Indicators for Predicting Skill Performance in Terms of Strength Variables for Some Muscles:

Table (3) Indicators of The Quality of The Linear Regression Equation Model

Variables		Correlation coefficient R	Contribution ratio (explanation factor) R2	Adjusted contribution ratio R2	Standard error of the estimate
Predictive	The result				
Skill performance	Electrical activity of the five muscles	0.904	0.818	0.590	0.524

It is shown in Table (3) the value of the multiple correlation coefficient was (0.904) and the value of the interpretation coefficient (contribution percentage) was (0.818). This means that the strength variables of some muscles explain a percentage of (81.8%) of skill performance. This indicates that the prediction of (skill performance) does not depend only on the strength variables of some muscles, but rather on other factors that are not included in the model. In general, the contribution ratio R2 indicates the amount of variance in the dependent variable that the model explains and is derived from the sample. The adjusted contribution ratio R2 indicates the amount of variation in the dependent variable (skill performance) that the model explains if it were derived from the population from which the sample was taken.

Table (4) It shows the calculated f-test value and the accompanying significance level value

Source of variance	Sum of squares	Degrees of freedom	Mean squares	f value		Statistical significance
				Calculated	significance level	
Between groups	4.928	5.000	0.986	3.595	0.000	basic
Within groups	1.097	4.000	0.274			
Total	6.025	9.000				

Table (4) indicates that the significance level value accompanying the calculated (f) value of (3.595) was (0.000), which is smaller than the significance level value (0.05), which indicates the significance of the multiple linear regression model. Therefore, the model best represents the

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relationship between the two variables under investigation (skill performance) and the strength variables of some muscles.

4-4 Extracting the Values of The Regression Equation Coefficients (The Model):

Table (5)

The values of the regression equation coefficients and the significance of the model parameters

Coefficient					T value		Statistical significance
The nature of the coefficient		The coefficient value of the equation			calculated	Moral level	
		Non-standard	Standard error	Normative (beta)			
Fixed amount	A	7.432	8.882		2.837	0.040	Moral
	B1	0.002	0.003	0.186	2.817	0.043	Moral
	B2	0.007	0.006	0.409	3.164	0.009	Moral
	B3	0.008-	0.007	0.341	4.050	0.003	Moral
	B4	0.007	0.005	0.479	4.288	0.007	Moral
	B5	0.007-	0.007	0.432-	2.893	0.022	Moral

Table (5) indicates the significance of the intercept coefficient (A) as well as the regression coefficients - the slope - (B1, B2, B3, B4, B5), as the significance level values accompanying the calculated (t) values were smaller than the significance level (0.05). Which indicates the significance of the parameters (A, B1, B2, B3, B4, B5) of the multiple regression model.

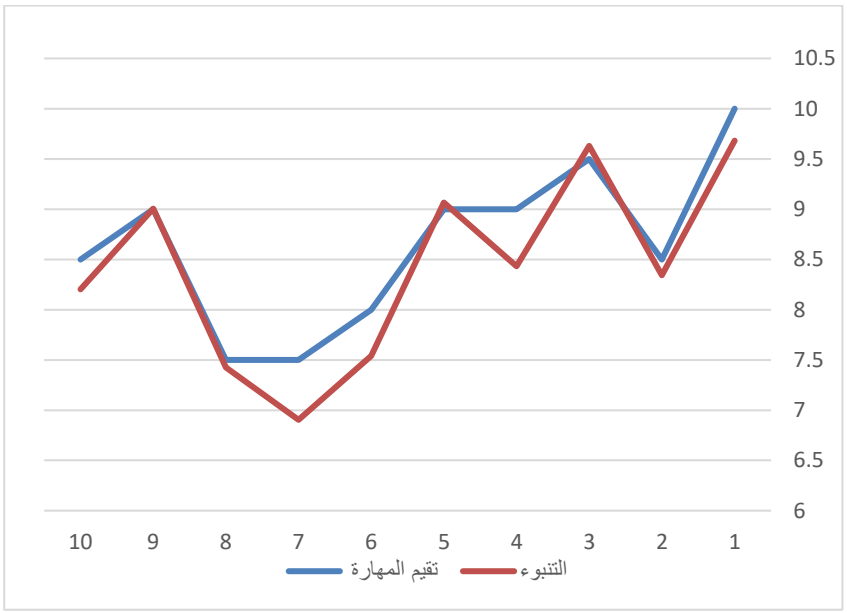

Figure (4) Shows the prediction values of skill variables

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During the previous figure, the hypothesis was achieved through the predictive equation that can be used in performance evaluation. It is also possible to know through any skill performance of working muscles, and it turns out that the equation contains the following variables:

Adjusted Regression: Dependent Variable = Constant Amount + Value of Electrical Activity Muscle 1* Factor 1 + Value of Electrical Activity Muscle 2* Factor 2 + Value of Electrical Activity Muscle 3* Factor 3 + Value of Electrical Activity Muscle 4* Factor 4+ Value of Electrical Activity Muscle 5 * Parameter 5

The researcher discussed these results, indicating that the amounts of muscular strength of the working muscles differ, whether it is isometric or isotonic force, depending on the type of muscular work and performance skills. Each muscle plays a special role in performing the skill. The player's body weight works downwards and the Earth's gravity works towards the center of the Earth (not his mass, because mass is not a force) [4]and the player tries to exert additional force in order to try to obtain balance.

This forces the player, under the influence of gravity, to exert isometric muscle contraction of the shoulder joints and adduction muscles equal to or slightly higher than the player's body weight so that he can overcome the resistance of the body weight and succeed in performing the skill[5]. Since the mechanical interpretation of the electrical activity of the working muscles depends largely on the skill of cruciate support on the throat apparatus in artistic gymnastics, Therefore, the essence of the work is that the body's joints work as levers that have the same characteristics as mechanical levers, by exerting a relatively simple effort in completing tasks that are difficult to accomplish with normal muscle strength. The use of the lever results in mechanical work that stabilizes the body. The shoulder joint represents the fulcrum of the lever in the study skill, and the muscular contraction of the muscles of the shoulder joints represents strength[6]. The weight of the body represents the resistance. Muscles generally work when they contract to move the joints. Muscle contraction has a force output that turns into torque for the moving bones due to their presence in a state of articulation with other bones, where the joint axis represents the axis of rotation of the moving limb. Here, the result of muscle contraction is torque, as the point of impact of the force is far from the axis and is determined after the muscle engages with the axis, so the player pulls the moving bones in the joint direction, and this is called balance[7]. The torque of the force is the amount of the force's ability to make the body rotate around a specific point or axis. This torque results from applying the force to the body without it passing through the center of rotation. This torque does not have an equal or opposite force. To understand the way the torque of the force is generated, imagine two people pushing the door. At the handle, with each person on one side pushing it with equal force, there will be a state of balance. However, when one of them stops pushing suddenly, the other person will push the door and move it, thus generating torque. The torque of a force about a specific point or axis is equal to the magnitude of the force multiplied by the perpendicular distance of the point of application of this force from the specific point or axis (force arm) [(Moment = Force x Distance or M = (F)(d)], and the center of the torque can be the

[4] Talha Hossam El-Din. **Biomechanics**, Cairo: Dar Al-Fikr Printing, 1993, p. 9.

[5] Hussein Mardan and Iyad Abdel Rahman: Biomechanics in Sports Movements, 2nd edition, Najaf, Dar Al-Diyaa for Printing and Publishing, 2018, p. 69.

[6] Doris. Miller and Richard C . Nelson; Biomechanics of sport (Philadeiphia, lea and febigfr,1973)p33.

[7] Yasser Najah Hussein, Ahmed Thamer Mohsen: Mathematical Kinetic Analysis, 1st edition, Dar Al-Diyaa for Printing and Publishing, Najaf, 2015, pp. 203-204.

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point In which the force causes rotation, or it may be a reference point or an axis in which the force can be considered to cause rotation, depending on the nature of the performance of the cruciate fulcrum skill (in other words, it does not matter as long as a specific point is taken as a reference point). The force-torque arm of the muscle working for the skill performed can be defined as the vertical distance between the line of force action, which is the straight line passing between the two points of contact of the muscle (origin and insertion) and the axis of the joint until the motor duty is accomplished so that the force torque depends on the position of the point at which the torque is taken with the body. To perform the cruciate fulcrum skill in an appropriate manner and according to the nature of the variables studied, such that it gives us the direction of the torque vector in the direction of rotation around this point resulting from the force, While its magnitude indicates how strong the rotational effect is, the shorter torque arm requires a greater force to overcome the resistance of the body weight[8]. This means that the force torque generated by the large rotator muscle, due to the system of levers, exerts a higher effort on the other muscles due to the length of the force arm [9]. These results are consistent with Ali's study. M., Abdul Rahman, and Talha Hussein, reported that the amounts of muscular force differ, whether it is equal or isotonic force, depending on the type of sports activity[10], These amounts also differ in different skills in the same sporting activity. These results are also consistent with James Jason, Tim McLellan, and others, who reported that performing the cruciate fulcrum skill on the throat apparatus requires a force that is the same as the force used to approximate the shoulder joints, for which the working muscles are responsible[11].

5-1 Conclusions

1- Muscle strength varies depending on its participation in technical performance
2- The force production of the working muscles is variable, and there are variations in the time and strength of force production
3- A predictive equation was extracted for the cruciate attachment skill

5-2 Recommendations

1- Trainers focus attention on anatomical aspects, especially the skill of cruciate attachment
2- Focus on electrical activity and attention to the mechanical aspects of the working muscles related to the performance of the cruciate attachment skill
3- Benefiting from the predictive equation that was deduced for the technical performance of the skill

[8] Sahar. M, Ahmed (1991) Effect of the proposed training program for the development of the record level of short distances events and electromyography for first grade students at the Faculty of Physical Education, Master thesis, Helwan university, EGYPT

[9] Cerulli, G., Caraffa, A., Ragusa, F. and Pannacci, M. (1998) A biomechanical study of shoulder pain in elite gymnasts. ISBS'98 XVI International Symposium on Biomechanics in Sports. University of Konstanz, Konstanz, Germany. Eds: Riehle, H.J. and Vieten, M.M. 308-310.

[10] Ali. M, Abdelrahman & Talha Husain (1988) Sports Kinesiology and Fundamentals of Movement Analysis, Arab thought house, Cairo, EGYPT.

[11] Tim McClellan. et al (1991) The iron cross, National Strength and Conditioning Journal, Volume 13, Number 6

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References

1. Ali. M, Abdelrahman & Talha Husain (1988) Sports Kinesiology And Fundamentals Of Movement Analysis, Arab Thought House, Cairo, Egypt
2. Cerulli, G., Caraffa, A., Ragusa, F. And Pannacci, M. (1998) A Biomechanical Study Of Shoulder Pain In Elite Gymnasts. Isbs'98 Xvi International Symposium On Biomechanics In Sports. University Of Konstanz, Konstanz, Germany. Eds: Riehle, H.J. And Vieten.
3. Hussein Mardan And Iyad Abdel Rahman: Biomechanics In Sports Movements, 2nd Edition, Najaf, Dar Al-Diyaa For Printing And Publishing, 2018,Doris.
4. Miller And Richard C . Nelson; Biomechanics Of Sport (Philadeiphia, Lea And -3 Febigfr,1973)
5. Sahar. M, Ahmed (1991) Effect Of The Proposed Training Program For The Development Of The-5 Record Level Of Short Distances Events And Electromyography For First Grade Students At The Faculty Of Physical Education, Master Thesis, Helwan University, Egypt
6. Tim Mcclellan. Et Al (1991) The Iron Cross, National Strength And Conditioning Journal, Volume 13, Number 6.
7. Wajih Mahjoub (And Others): Scientific Research Methods And Curricula In Physical Education, Baghdad, Higher Education And Scientific Research Press, 1988 Ad.
8. Wajih Mahjoub: Kinetic Analysis, 1st Edition, Higher Education Press, Baghdad, 1987.
9. Yasser Najah Hussein, Ahmed Thamer Mohsen: Sports Kinetic Analysis, 1st Edition, Dar Al-Diyaa For Printing And Publishing, Najaf, 2015.

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