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The impact of a rehabilitation program to develop neural conduction speed (EMG) and thrust strength of hip joint muscles to reduce injuries in freestyle swimmers.

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Abstract

The study aims to:

Investigate the impact of a rehabilitation program on developing neural conduction speed using EMG and the thrust strength of hip joint muscles to reduce injuries in freestyle swimmers. The researchers used the experimental method for its suitability to the nature of the research, employing an experimental design with two groups: an experimental group and a control group. The sample was intentionally selected, consisting of 12 freestyle swimmers divided into the experimental group (6 players) and the control group (6 players) aged between 17 and 19 years. Homogeneity and equivalence were ensured among all variables.

The rehabilitation program was applied for 12 weeks, with 3 weekly sessions, combining proprioceptive neuromuscular facilitation (PNF) exercises and plyometric exercises with body weight and additional weights. Data were collected through the used measurements and statistically processed. The research procedures included pre- and post-tests over 3 months of the program's application.

The key findings revealed that the proposed rehabilitation program positively affected neural conduction speed variables, thrust strength, electrical activity, and physical variables. Additionally, it helped reduce the discrepancy in muscle strength balance between the working and opposing muscles, thereby minimizing injuries.

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اثر برنامج تأهيلي لتطوير سرعة التوصيل العصبي (EMG) وقوة الدفع لعضلات مفصل الفخذ للحد من الإصابة للاعبي السباحة الحرة

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الملخص

هدف البحث الى اثر برنامج تأهيلي لتطوير سرعة التوصيل العصبي استخدام (EMG) وقوة الدفع لعضلات مفصل الفخذ للحد من الإصابة للاعبي السباحة الحرة، استخدم الباحث **المنهج** التجريبي نظراً لملائمته لطبيعة البحث وذلك باستخدام تصميم تجريبي المجموعتين التجريبية والضابطة ، وتم اختيار **العينة** بالطريقة العمدية وعددهم (١٢) من لاعبي السباحة الحرة مقسمين إلى المجموعة التجريبية (٦) لاعبين والمجموعة الضابطة (٦) لاعبين تتراوح أعمارهم من (١٧ – ١٩) سنة وتم إجراء التجانس والتكافؤ بينهم في جميع المتغيرات ، وتم تطبيق البرنامج ألتأهيلي لمدة ١٢اسبوعا بوقع ٣وحدات بالأسبوع والذي يحتوي على المزج بين تدريبات التسهيلات العصبية العضلية للمستقبلات الحسية (PNF) وتدريبات البليومتري بوزن الجسم وبالأوزان الإضافية ، تم جمع البيانات عن طريق القياسات المستخدمة ومعالجتها إحصائياً، وتضمنت اجراءات البحث ذو الاختبارات القبلية والبعدية على مدى ٣ اشهر التطبيق البرنامج وتم التوصل إلى **أهم النتائج** وهي إن البرنامج التأهيلي المقترح قد أثر تأثيراً إيجابياً على متغير سرعة التوصيل العصبي ومتغيرات قوة الدفع والنشاط الكهربي والمتغيرات البدنية وكذلك أدى إلى تقليل الفارق في نسب توازن القوة العضلية بين العضلات العاملة والمضادة وذلك للحد من الإصابة .

الكلمات المفتاحية : البرنامج التأهيلي، **التوصيل العصبي** (EMG) ، للمستقبلات الحسية (PNF) .

Introduction

What we see today of clear and noticeable progress in the field of sports at the global level, taking broad and rapid steps forward, is nothing but the result of the equivalence and overlap of a large number of theoretical and applied sciences that would benefit the sports aspect and increase the possibility of achieving the best level in it. Among the important sciences that the world has recently begun to rely on are the sciences of physiology and the study of the functions of organs and the nature of the means that would increase the possibility and efficiency of these functional or motor devices. (Alaa Ahmed Zidane Khalaf, 25-26-2014).

various types of sports activities and events. It defines sports as functional, which

determines the possibility of exercising the appropriate type of sports activity, so that its ability and level of achievement can be developed in accordance with physiological principles and principles, and in an informed scientific manner in order to reduce the risks associated with exercises that are not based on sound physiological norms and that are not suitable for the type of activity. The high intensity of the effort placed on physical organs during sports activities requires functional adjustment and multiple functions in the muscle or nervous system to suit motor capabilities. Increased effort needs to lift the nervous charge to counter mathematical achievement, and muscular activity reflects the results of multifaceted functions in the exchange of substances, both in the muscle and in the nervous system. (Samia Khalil Mohammed 114, 2008)

Studies of the functional adaptation of different body organs in their attempt to move closer to the applied reality of the sports field have indicated that the increase in functional activity rates under the influence of regular physical training determines the body's response to physical pregnancy and the limits on which different body organs can operate to determine training methods and composition of their content. Baha' al-Din Ibrahim Salama (2000, 28) mentions.

Baha ' din Ibrahim Salama 2008 states that when examining the functional responses to training, we must distinguish between the rapid response that occurs as a result of working for a specified period or carrying out a physical effort once, from the response that occurs as a result of work or carrying out physical effort for several months. The last is what we call adjustment. When we train for weeks and months regularly, the physiological adaptation of this effort or work takes place while improving individual physical and functional capabilities, as well as improving efficiency, affordability and various other technical aspects associated with specialized activity.

Al-Ala Abdel,1995,66. indicate that the central nervous system is responsible for the responses of the parties and for organizing the work of muscles involved in performance and muscle contractions, the amount of strength, the speed and accuracy of the body movement and the changes in the rhythm of movement, which means coordinating the efficiency of the processes involved in motor performance in connection with the desired objective, depending on how the body organs function duringthetraining.

The functional state of the nervous system reflects an individual ' s ability to master motor skills that are characterized by speed and mobility, so skill mastery requires the integrity of the nervous system through a balanced and compatible transmission of neurological fluids, where structural muscles receive neurological signals from the motor nerve nerve to perform the process of muscular contraction and motor performance, whether physical or skilled. The importance of studying

neuroadjustments and changes in the nervous system as a result of being subjected to many variables such as training programmes makes us understand that whenever the tendencies are systematic and sequenced, the resulting movement can be described as a skilled movement, which is the robotic function of complex skill, meaning that all brain waves are together in regular harmony and in harmony and balance of all

situations.Mohammed,JalalFaydallah(2014,22,23).

Research problem:

An important physiological variable is the speed of neural conductivity and the indicators of electrical activity, as they are among the most important physiological indicators that reflect the functional status of the nervous and muscular systems, the ability of the player to master motor skills characterized by speed and kinetic compatibility, and the retention of its mathematical level to the maximum extent possible, which is one of the important indicators that reflects the ability of the athletes to perform and master various skilled abilities and speed in the neuromuscular compatibility of athletes. (Ala Ahmed Zeidan Khalaf, 26, 25, 2014) From this point of view, as a result of previous studies, it is clear that the neurolinking of athletes and the muscle balance between the muscles working and the antagonistic on the knee joints were studied. The researcher focused on designing a rehabilitation programme to reduce the incidence of free swimmers using extra weight polymetric trainings and mixing them with proprioceptive Neuromuscular Facilitation exercises during the programme units to develop the speed of the conductivity, as well as to balance the muscle strength of the muscles working and the antidote on the knee joint to develop the momentum, as it has an impact on the performance of the players, and is reducing therate of knee joint injuries to the players.

Purpose:

1. To identify a variable dynamic (neural delivery speed) by measuring (inter-, inter-, and post-) between the experimental group and the command group.
2. To identify the dynamics of variables (drive power) by measuring (preliminary, pinet, and post) between the experimental group and the commanding group.
3. Identification of the dynamics of physical variables (molecular force, muscle balance, motor performance) through measurement (tribal, pinetular, and postural) between the experimental group and the command group.

Hypothesis:

1. There are statistically significant differences between the measurement (inter-, inter-, and remote) of the neurotransform speed variable between the

experimental and the commanding groups and for the dimensional measurement of the experimental group.

2. There are statistically significant differences between the measurement (tribal, inter-, and remote) in the variable (drive power) of electrical activity between the experimental and the commanding groups and for the dimensional measurement of the experimental group.
3. There are statistically significant differences between measurement (i.e. tribal, inter-urban, and remote) in the physical variables (improvement of muscle strength, muscle balance, motor performance) between the experimental and the commanding groups and for the telemetry of the experimental group.

Methods:

The research sample was chosen intentionally and included 12 players who were divided into two groups: an experimental group (6) players and a control group (6) players. They were equal players from the University of Mosul national team in Mosul Governorate.

The researcher used the experimental method due to its suitability to the nature of the research by using the experimental design for two groups, an experimental group to which the proposed rehabilitation program is applied and a control group, and pre-and post-measurement is conducted for all variables under study for both groups.

:Method of performance

Two surface electrodes were placed on the quadriceps femoris muscle of the right and left leg, and two surface electrodes were placed on the biceps femoris muscle of the right and left leg.

The quadriceps femoris and biceps femoris muscles were identified by referring to studies, scientific references, and physical medicine experts Rafed Habib Qaddouri (2012, 68).

Before placing the sensors, the hair was shaved and the area where the sensor was attached was wiped with alcohol to remove skin secretions and conjugated skin to .reduce the skin's resistance to electrical signals and obtain a good (EMG) signal

The sensors were attached to the top of the middle of the muscle and one additional sensor was placed near the rectus femoris muscle of one of the legs, which works to remove the electricity that the body receives from the surroundings and is called the .ground sensor

To determine the movement of the wires, they were fixed with medical adhesive tape .in the leg, thigh and around the waist

The (EMG) device was fixed around the player's waist, specifically the lower back above the hips, using a special belt that keeps the device from falling while giving freedom of movement and without any effect on the player's motor path while .performing the test

The (E.M.G) device receives the electrical signal of the muscle via the wires connecting it to the sensors The surface sensors attached to the muscles send the signal in the form of a (Bluetooth) signal remotely to the receiver connected to a personal computer (Laptop). The function of the surface sensors attached to the muscles after we ask the tester to perform the test is to detect the electrical current in the activated muscles and convert it to the computer screen to show the strength and shape of the signal via a (Software Program) program, which analyzes the stored data and provides useful reports on muscle activity.

Statistical methods:

The researcher used the social statistical package SPSS, from which each of the following was extractedwere used to statistically process the data. The SPSS statistical package version was used. The T-test was used to calculate the mean, the T-test was used to calculate the differences between groups, and the standard deviation. The law of percentage coefficient differences between groups for a common variance to compare the statistical differences between the post-test means of the experimental and control groups after adjusting them according to their corresponding post-tests as common variables. Statistical comparisons were conducted.

Result:

Table (1) Differences between the experimental group and the control group in the primary variables before the experiment (equivalence)

Variables	Groups	N	The arithmetic mean.	Std. Deviation	The differences between the averages.	The value of T.
Length (cm)	The experimental group.	6	181.00	8.09	1.33	0.208
	The control group.	6	179.67	7.55		
Weight (kg	The experimental	6	67.67	7.257	0.83	0.208

	group.					
	The control group.	6	66.83	6.616		
Body Mass Index (BMI)	The experimental group.	6	20.47	1.53	-0.078	-0.845
	The control group.	6	20.72	1.955		
Training age (years)	The experimental group.	6	5.33	0.516	-0.845	-0.33
	The control group.	6	5.67	0.816		
Age in years.	The experimental group.	6	17.83	0.983	0.00	0.001
	The control group.	6	17.83	0.753		

It is clear from Table (1), which pertains to the differences between the experimental group and the control group in the basic initial variables before the experiment, that the calculated t-values ranged from (0.078 to 0.295). These values are smaller than the tabulated t-value at the 0.05 level, indicating that there are no significant differences between the two groups and confirming that there is equivalence between the research groups in the basic initial variables before the experiment.

Variables	Groups	N	The arithmetic mean.	Coefficient of skewness	Torsion coefficient	The mediator
Right knee joint (flexion)	The experimental group.	**6**	**52.000**	**4.382**	**0.750**	**51.000**
	The control group.	**6**	**53.667**	**4.460**	**-0.280**	**53.500**
Right knee joint	The experimental group.	**6**	**171.000**	**4.461**	**0.280**	**171.000**

(extended)	The control group.	**6**	**170.000**	**1.549**	**0.002**	**171.000**
Left knee joint (flexion)	The experimental group.	**6**	**52.167**	**3.312**	**1.0320**	**51.000**
	The control group.	**6**	**52.166**	**2.786**	**0.006**	**52.000**
Left knee joint (extended)	The experimental group.	**6**	**170.667**	**-0.250**	**1.751**	**17.500**
	The control group.	**6**	**169.500**	**1.379**	**-1.371**	**170.000**

It is clear from Table (2) regarding the homogeneity of the research sample data in measuring the variables of the range of motion of the knee joint that the torsion coefficients range between (0.250- to 1.320), which indicates that the extracted measurements are close to the normal curve, as the values of the torsion coefficient range between (±3), and this indicates the homogeneity of the sample individuals in the variables of the range of motion of the knee joint before the experiment.

Table No. (3) shows the differences between the experimental group and the control group in the variable of the range of motion of the knee joint (degree) in the dimensional measurement.

Variables	Groups	N	The arithmetic mean.	Coefficient of skewness	Torsion coefficient	The mediator	Difference % ratio
Right knee joint (flexion)	The experimental group.	**6**	**44.833**	**3.312**	**7.333**	***3.76**	**%14.057**
	The control group.	**6**	**3.430**	**52.166**			

Right knee joint (extended)	The experimental group.	**6**	**175.667**	**1.632**	**4.000**	**5.071***	**%2.330**
	The control group.	**6**	**171.667**	**1.032**			
Left knee joint (flexion)	The experimental group.	**6**	**46.167**	**3.600**	**5.333**	**3.074***	**%2.330**
	The control group.	**6**	**51.500**	**2.258**			
Left knee joint (extended)	The experimental group.	**6**	**175.000**	**1.414**	**4.333**	**5.398***	**%2.538**
	The control group.	**6**	**170.667**	**1.366**			

Table No. (3) regarding the differences between the experimental and control groups in the variable of the range of motion of the knee joint in the dimensional measurement shows that there are significant differences between the experimental and control groups in all measurements in favor of the experimental group, as the calculated t value was between (3.074: 5.398) and these values are greater than the tabular t value at the 0.05 level, and the percentage of differences between the two groups was between (2.330%: 14.057%) in favor of the experimental group.

Table (4) Statistical description of the experimental and control groups in (measuring nerve conduction velocity before the experiment (meter/second

Nerves	Variables	Groups	N	Arithmetic mean	Standard deviation	Coefficient of skewness	The mediator
femoral nerve	Nerve conduction velocity of quadriceps muscle right	Experimental group	6	67.583	5.371	-0.750	68.402
		Control group	6	65.133	10.619	0.810	60.650
femoral nerve	Nerve conduction velocity of left quadriceps muscle	Experimental group	6	65.800	7.161	0.940	62.050
		Control group	6	63.833	11.872	0.860	61.550

It is clear from Table (3) regarding the homogeneity of the research sample data in measuring nerve conduction velocity that the skewness coefficients range between (-0.750 to 0.940), which indicates that the extracted measurements are close to the normal curve, as the skewness coefficient values range between (±3), and this indicates the homogeneity of the sample individuals in the nerve conduction velocity variable before the experiment

Table No. (4) shows the differences between the experimental group and the control group in the variable of nerve conduction velocity (meter/second) in the dimensional measurement.

Statistical implications / Variables	Groups	N	Arithmetic mean	Standard deviation	Differences between the two averages	Value (t)	Difference %
Nerve conduction	Experimental group	6	76,067	٤.٠٧٤٩	9,833	*2.152	%14.84

velocity of quadriceps (muscle (right	Control group	6	66,233	10,427			
Nerve conduction velocity of quadriceps (muscle (left	Experimental group	6	75,500	4,287	10,617	*2.126	%16.37
	Control group	6	64,883	11,456			

Table No. (4) regarding the differences between the experimental and control groups in the variable of nerve conduction velocity of the right and left quadriceps muscle in the dimensional measurement shows that there are significant differences between the experimental and control groups in all measurements in favor of the experimental group, as the calculated t value was between (2.126: 2.151) and these values are greater than the tabular t value at the 0.05 level, and the percentage of differences between the two groups was between (14.84%: 16.36%) in favor of the experimental group.

Findings and Discussion:

The experimental group's use of modern training methods used during the proposed rehabilitation program also led to the development of the types of mobile muscle contractions by increasing the speed of contraction through the speed of the frequency of nerve signals, thus shortening the duration of muscle contraction, which leads to an increase in the resulting muscle force.

The development of muscle strength and improve balance muscle strength ratios between the muscles working and counter the knee joint party one and between the two sides (left and right), where the proportion of differences experimental group between (9.864: 12.066) Party Wahid (right and left), while the differences of the control group proportion between (0.100: 4.994) party Wahid (right and left), as the proportion of differences experimental group between the total (19.703: 25.667) between the two sides (left and right), while the differences of the control group rate of between (9.970: 12.880) between the two sides (left and right).

Result:

Table No. (1) shows the analysis of variance (ANOVA) between the three measurements (pre, inter, and post) in the variable of nerve conduction speed of the knee joint muscles (meters/second) for the experimental group

It is clear from Table (3) and the graph (4) for the analysis of variance (ANOVA) between the three measurements (pre, inter, and post) in the nerve conduction velocity variable for the experimental group, that there are significant differences between the three measurements in the nerve conduction velocity variable of the right and left quadriceps muscle. As explained by Suad Abdul Hussein and others (2013), the physiological reason for the increase in electrical activity when the strength of muscle contraction increases is the increase in the speed of the frequency of nerve signals, which leads to an increase in the number of motor units involved in this contraction, as well as an increase in their synchronization in work during the contraction.

Discussion:

The improvement in nerve conduction speed for the groups that receive resistance training during the program may be due to the improvement in neurotransmitters, that is, there may be an improvement in the efficiency of acetylcholine in the neuromuscular synapse area, as excitement can enhance the work of the excitatory neurotransmitter or stop the work of the transmitter. Abu Al-Ala Abdel Fattah (2003) also adds that the nervous system controls motor performance at all levels using different neural methods and levels by mobilizing motor units to participate in muscle contraction according to the amount of resistance facing the muscle. It is not necessary for an individual to need to produce 100% muscle strength, but on the contrary, most of the work performed by the muscles always requires a lower percentage to varying degrees. The more efficient the process of controlling the production of the exact amount of force required, the more accurate and economical the motor performance is. (2: 111, 118)

Recommendations:

Depending on this study results, the researcher reached the following recommendations:

1. The researcher recommends the importance of using rehabilitation programs with the training program during preparation period before competitions to avoid and limit injuries.

2. The researcher recommends the importance of developing the nerve conduction velocity and momentum for working muscles on knee joint through rehabilitation program to limit injuries.

3. The importance of applying the rehabilitation programs collected between exercises of Proprioceptive Neuromuscular Facilitation (PNF) and Plyometric

exercises for working and opposing muscles on the knee joint considering with the skillful program during preparation.

4. The researcher recommends the importance of measuring electric activity through movement and measuring muscular strength balance to limit wasted percentage in muscular strength for working and opposing muscles on knee joint and using it as a predictive index of injury occurrence or avoidance.

5. The importance of developing the dynamic range through developing muscular prolongation of working and opposing muscles on the remaining body joints using the remaining Proprioceptive Neuromuscular Facilitation (PNF) to limit injuries resulting from lack of joint dynamic scope.

6. Using these study results when applying players rehabilitation programs to the remaining joints to avoid muscular strength balance waste between working and opposing muscles on the joint to limit athletic injuries.

7. Variegating the rehabilitation program through using Plyometric training in water medium in the rehabilitation programs to limit injuries.

Conclusion:

Recommendations: Applying rehabilitation program for players including mixing Plyometric exercise using additional weights and (PNF) exercise on the remaining body joints to limit players' athletic injuries.

The researcher recommends the importance of measuring electrical activity during movement and measuring muscle strength balance to reduce the percentage of loss in muscle strength of the working and opposing muscles on the knee joint and using it as a predictive indicator of injury occurrence and prevention.

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