Special exercises for some physical, kinetic and electrical abilities accompanied by symmetrical electrical stimulation in the rehabilitation of the muscles of the legs for patients with simple hemiplegic cerebral palsy

Hasnaa Ali Mahmood [(1)] , Prof. Dr. Mohammed Jawad Kadhim [(2)]

[(1)] Master. Student. College of Physical Education and Sports Sciences / University of Baghdad, Iraq.

[(2)] College of Physical Education and Sports Sciences / University of Baghdad, Iraq.

Hasnaaalialqaisi@gmail.com , dr.muhamed.juad@cope.uobaghdad.edu.iq

Abstract

The purpose of this paper is to identifying some of the physical, kinetic and electrical capabilities of the working muscles of patients with simple hemiplegic cerebral palsy, preparation of special exercises (rehabilitation and water) accompanied by symmetrical electrical stimulation in the rehabilitation of working muscles for patients with simple hemiplegic cerebral palsy, and identifying the effect of exercises, especially (rehabilitation and water), accompanied by symmetrical electrical stimulation, on some physical, kinetic and electrical capabilities in rehabilitating working muscles for patients with simple hemiplegic cerebral palsy. The researcher used the experimental approach with a one-group design with two pre and post-tests due to its suitability to the research problem. The research population consisted of patients with simple hemiplegic cerebral palsy resulting from various injuries. The research sample consisted of patients with simple hemiplegic cerebral palsy and they have damage to the left part of the brain, i.e. paralysis in the right part of the body and the number of (5) injured men over the age of (35) years. They have control over their own needs (urination and excretion). One of the most important results reached by the researcher is that: The early rehabilitative approach is more useful in rehabilitating the muscles that the induction does not reach, and use of symmetrical electrical stimulation is better than the use of external stimulation whose intensity is not controlled. One of the most important recommendations recommended by the researchers is that: Need to unify the rehabilitation curricula in the Iraqi Ministry of Health and rehabilitation centers, and necessity of adhering to medical prescriptions after the injury and then moving to rehabilitation.

Introduction:

The individual faces limitations in daily performance due to old age or a health condition including diseases or injuries, as there is a need for a group of medical or semi-medical interventions, and therefore individuals of all ages can be rehabilitated, maintain their daily life activities, and return to it. Injuries can have immediate and significant adverse effects on bodily functions.

Normal people may have a problem or an accident that causes them to have a brain injury, and this affects their ability to cope with changes in their behavior or their physical and sensory abilities. Brain injuries and the disabilities they cause can be temporary or permanent. Symptoms of hemiplegia range from one person to another and depend on the severity of the injury. There is no doubt that the process of rehabilitating cerebral palsy patients is one of the things that needs people with extensive experience in this field to enable them to carry out their duties properly.

Sports rehabilitation combines exercises with other methods of treatment such as electrical stimulation, hydrotherapy, and others. To restore a high level of performance, sports rehabilitation is an important aspect of treatment. Paraplegics should also undergo a combination of rehabilitation therapy.

From here came the importance of the research by preparing the researcher for a varied rehabilitation curriculum using special exercises (rehabilitation and water) accompanied by symmetrical electrical stimulation in the rehabilitation of working muscles for patients with simple hemiplegic cerebral palsy. Some of the physical, kinetic and electrical capabilities of the affected muscles are improved. Where the researcher tries to contribute to improving the rehabilitation of cases of simple hemiplegic cerebral palsy in order to achieve their compatibility with the environment and society. The study also indicates the importance of diversifying the exercises used in rehabilitation by linking symmetrical electrical stimulation with water and physical exercises.

Research problem:

Rehabilitation programs take an important role in the health of society, because they have an important role in returning individuals to their normal position to practice their daily life activities normally, through the researcher's wanderings in governmental and private centers to see the rehabilitation programs for patients with simple hemiplegic cerebral palsy. She noticed the lack of variations in giving exercises In terms of the link between electrical stimulation, water exercises, and physical exercises, this is what prompted the researcher to give rehabilitative exercises that are linked in the use of joint work between electrical stimulation and exercises in a way that provides the injured person, even if close to what he was before the injury. Therefore, the researcher decided to develop an integrated and diversified rehabilitation approach to shorten the rehabilitation period and give better efficiency in rehabilitating patients to practice their lives in a way that they depend on themselves in their daily life activities. In addition, make it a reference for governmental and private rehabilitation clinics to serve the patients.

The research seeks to answer the following questions:

- What are the possibilities of linking between electrical stimulation, water exercise, and physical, kinetic, and electrical abilities?
- What is the extent of the effect of rehabilitative and water exercises accompanied by symmetrical electrical stimulation on the physical, kinetic and electrical capacities in the rehabilitation of working muscles for patients with simple hemiplegic cerebral palsy?
- What are the effects of the proposed rehabilitation approach on the duration and efficiency of rehabilitation of patients with simple hemiplegic cerebral palsy?

Research objective:

- Identifying some of the physical, kinetic and electrical capabilities of the working muscles of patients with simple hemiplegic cerebral palsy.
- Preparation of special exercises (rehabilitation and water) accompanied by symmetrical electrical stimulation in the rehabilitation of working muscles for patients with simple hemiplegic cerebral palsy.
- Identifying the effect of exercises, especially (rehabilitation and water), accompanied by symmetrical electrical stimulation, on some physical, kinetic and electrical capabilities in rehabilitating working muscles for patients with simple hemiplegic cerebral palsy.

Research hypotheses:

- There are statistically significant differences between the pre and post-test in some physical, kinetic and electrical abilities of the working muscles of patients with simple hemiplegic cerebral palsy and in favor of the post-test.

Research fields:

- Human field: Patients with simple hemiplegic cerebral palsy over the age of 35, men.
- Time field: (15/11/2022) to (20/3/2022)
- Spatial field: Al-salam Center for the Rehabilitation of the Disabled

Research methodology and field procedures:

Research Methodology:

The researcher used the experimental approach with a one-group design with two pre and post-tests due to its suitability to the research problem.

Community and sample research:

The research population consisted of patients with simple hemiplegic cerebral palsy resulting from various injuries. The research sample consisted of patients with simple hemiplegic cerebral palsy and they have damage to the left part of the brain, i.e. paralysis in the right part of the body and the number of (5) injured men over the age of (35) years. They have control over their own needs (urination and excretion).

To fully achieve homogeneity, the researcher relied on the foundations of injury, which were identified by Dr. Mahmoud Hussein at the Al-Salam Center for the Rehabilitation of the Disabled:

- Homogeneity in the degree of injury: All members of the research sample were patients with simple hemiplegic cerebral palsy through the first and last survey of the sample.
- Homogeneity in the duration of the infection: all the injured who had a recent infection that did not exceed two weeks. Those who are recommended by the doctor to do rehabilitation treatment for them.

Field research procedures:

Determining the study variables and their tests:

After consulting with the supervisor and taking the opinion of the specialist, the researcher will measure each of the following variables for the research sample:

- The muscular strength of the two legs. (the front and back quadriceps muscles, the gluteus Maximus, and the twins muscle)
- Muscular strength of the arms. (Forearm muscles, shoulder muscles)
- Grip strength.
- Flexibility (range of motion) of the joints of the upper and lower extremities (knee, hip, shoulder, elbow, wrist)
- Muscle electrics.

Tests and measurements used in the research:

First: strength tests for the injured leg: ((Aljorani, A. 2023)

A- Strength of the front and back thigh muscles.

- Test Name: Tensile test for the front and back muscles of the thigh.
- The aim of the test: measuring the degree of strength of the posterior and anterior thigh muscles.
- Tools used: a device for measuring muscular strength, a floor exercise mat, a step and two assistants.
- Method of performance:

- Measuring the strength of the posterior thigh muscles: the tester lies on his stomach with the device behind him, and connects the device below the ankle with a metal wire, and the performance angle is (130-170) degrees, as the tester pulls the wire with the back thigh muscles. As in Figure No. (2) .
- Measuring the strength of the front thigh muscles: the injured player climbs over the device to measure the strength of the front thigh muscles at an angle of (80-130) degrees. By wire - the same as in Figure. (1)

- Test conditions:

- Pain limitation test.
- Stability for (5) seconds when pulling the metal wire.
- The knee flexion angle to measure the strength of the posterior thigh muscles is (130-170) degrees.
- The angle of extension of the knee to measure the strength of the anterior thigh muscles is (80-130) degrees.
- Rest (1) minute between attempts.

Figure (1) Shows the strength test for the anterior and posterior thigh muscles

B- Leg muscle strength: ((Aljorani, A. 2023)

- Test Name: Golf Test
- The aim of the test: measuring the maximum strength of the calf muscle (calves or calves).
- Tools: a machine (Lake Press) with different weights.
- How to perform the test: From the supine position, raise the legs up and place the combs on the device. The tester lies on the device and the hip is directly below the level of the high feet as shown in Figure (2). The tester rests the combs on the cushion designated for the feet of God. The tester presses the cushion with the metatarsals with the legs straight without bending the knee. The tester puts his hands behind the buttocks, with their palms facing down.
- Registration: Three attempts are given, and the highest weight of the attempt is recorded correctly.

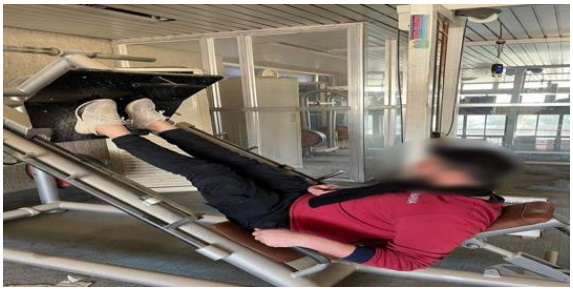

Figure (2) shows the golf test

Second: strength tests for the injured arm: (Aljorani, A. 2023)

A- Forearm muscle strength

- Name of the test: the wrist-up twist test.
- The aim of the test: to measure the maximum strength of the forearm muscles.
- Tools: (dumbbells), small discs of different weights.
- Method of performing the test: the tester sits and holds the small rod and places his forearm on the bench with the palm facing upwards, then he raises the short rod (dumbbell) up in a straight line until the hand reaches its maximum height and the forearm is fixed in its place, and the test is repeated for the other hand, as in Figure (3).
- Registration: Three attempts are given, and the highest weight of the attempt is recorded correctly.

Figure (3) Shows the wrist-up twist test

B- Hand Grip Strength: (Hassanin, 2003, page 2010)

- Name of the test: Static strength test (grip strength test).
- The purpose of the test: to measure grip strength.
- Instruments: Dynamometer, Magnesia powder.
- Method of performing the test: the tester dips his hand in the magnesia powder. Then he holds the device in the hand of the distinguished palm to squeeze it out with the strongest possible force. As shown in Figure (4).
- Recording: The indicator of the device indicates the strength of the tester's grip (the tester has the right to three attempts to record the best of them).

Figure (4) Shows the Static strength test (grip strength test).

C- Shoulder muscle strength: (Muhammad, 2013, p. 65)

- Name of the test: Measuring the strength of the shoulder muscles in the movement (abduction-adduction) until pain is felt
- The aim of the test: measuring the strength of the shoulder muscles in the (abduction-adduction) movement.
- Tools used: a dynamometer to measure muscle strength, a leather belt.
- Description of performance: The injured person sits on a seat with a backrest, fixes the body of the injured person on the seat so that it isolates the muscular work of the rest of the body, then holds the grip of the dynamometer, and dwarfs the injured person to perform the required movement. As in Figure (5).
- Recording: The resistance is measured in kilograms until the pain begins.

Figure (5) shows the Measuring the strength of the shoulder muscles in the movement (abduction-adduction) until pain is felt

7- The ninth test: (Mohammed et al., 2021)

- Test name: Electromyography (EMG).
- The aim of the test: to measure the wave area and wave crest of the working muscles.
- Devices and tools used: Electromyography device (EMG) (Samsung) receives the signal and

transmits it via a rechargeable Bluetooth weighing 250 gm, connecting cables between the electrodes and the device, surface electrodes (electrodes) number (4) for each muscle, a remote signal receiving device that is sensitive to the frequency of the device The sender, an application program for the device (SOFT WARE) supported by the manufacturer, medical cotton, esperto, razors, a camera type (Canon), a computer type (DELL) as shown in Figure (6)

- How to perform: EMG device working steps:

- Before opening the EMG program, the place of the muscle is shaved in order to remove hair from the area, and then it is cleaned with Esperto solution. It must be stressed here on the importance of cleaning the area in order to remove the light layer of dirt that affects the electrical signal.
- We place surface electrodes to record the electrical activity, and the electrode closest to the stimulating kinetic unit records a larger EMG signal and records a smaller signal if the stimulating kinetic unit is far from the electrode. The surface electrode is the most used in analyzing human movements in addition to recording them. The signals that pass under the surface of the surface pickup, and the electrical signals are also recorded. The surface pickup consists of a small metal disk with a diameter of 1 cm. It can be of a smaller size if small muscles are to be tested. The pickup is made of silver chloride and has high sensitivity to the electrical signal emanating from the muscles close to the skin. These sensors work to record the signal that indicates the rate of electrical activity. As for the function of the surface sensors, which will be attached at the top and middle of the muscle after we ask the laboratory to contract the muscle, it detects the electrical current in the activated muscles and transfers them to the computer screen to show the strength and shape of the signal through a program (Software Program) as it analyzes the stored data and gives useful reports about muscle activity, and two antennas have been placed for each muscle. The modern EMG device is a device weighing no more than (250) grams that is tied around the lab's waist with a belt. This device sends Bluetooth signals about muscle activity to be received by another device known as the receiver for a Bluetooth signal connected to a personal computer (Lap Top). The modern EMG device is distinguished by allowing the laboratory to perform movements at a distance of 20 meters from the site of the receiver for the signal to record and store the EMG signal, which represents the time of the beginning and end of the muscle activity and the peak of the muscle wave with the working area of the muscles working in the movement.
- The EMG program on the computer (Lap Top) is opened and the muscles that we want to study are electrical.
- We connect the camera to the computer, turn on the bluetooth signal, and then instruct the laboratory to make the required movement, so the signal appears with the image on the computer.
- After completing the movement, the electromyography of each laboratory is saved.

- Register: The values of the wave crest and its area will be calculated for some working muscles that were measured, through the analytical program of the EMG device connected to the computer.

The values of this test will be recorded in combination with the values of the muscular strength tests for the muscles affected by simple hemiplegic cerebral palsy. These muscles are (front and back thigh muscles, golf muscle, forearm muscles), as in Figure (8)

Figure (7) Shows the Electromyography (EMG)

Figure (8) Shows the muscles measured for EMG testing.

Fourth: Tests of the range of motion of the injured leg:

A- Measuring the range of motion (extension - flexion) of the knee joint of the injured leg: (Zaqair, 2018):

First: measuring the range of motion of the knee in the case of stretching.

- Purpose of measurement: The test aims to measure the range of motion of the knee joint in the case of extension.
- Tools used: a goniometer, a lying couch, and a registration form.
- Description of the measurement method: The tester stands beside the tester (the patient) while he is lying on the bench, and the (gonometer) device is placed on one side of the affected knee area, the lateral or medial side, then the tester is asked to extend the injured leg forward and the moving arm of the device moves with The axial line mediastinum of the injured leg, and the other remains fixed in its first position, and the angle between the two arms of the (gnometer) is read, and it represents the tidal angle of the knee joint. As in Figure (9).
- Recording: The index of the (Gonometer) indicates the measurement of the range of motion of the knee joint in angular degrees.

Figure (9) shows the measurement of the range of motion of the knee in the case of stretching with a device (Genometer)

Second: Measuring the range of motion in the case of bending.

- The purpose of the measurement: measuring the range of motion of the knee joint in the case of flexion.
- Tools used: a gnomometer, a lying couch, and a registration form.
- Description of the measurement method: The tester stands beside the tester while he is lying on the couch, and then asks the injured person to bend the injured leg inward to the maximum degree he can take the measurement using the fixed and movable arm, which refers to the range of motion of the joint, as in the figure. No. (3-10)
- Recording: With one attempt, the reading is taken in angular degrees.

Figure (10) show the measurement of the range of motion in the case of bending with a device (Genometer)

B- Measuring the range of motion of the hip joint: (Michael P. Riman, 2009, p. 73)

First: Measuring the range of motion from the supine position.

- Name of the test: Raise the leg to the top of the thigh joint as far as possible from the supine position.
- The aim of the test: measuring the range of motion of the hip joint from the supine position.
- Initial position: the laboratory takes the position of lying on the back and fixes the device on the outer side of the hip joint in a straight line with the spine as shown in the figure below.
- Method of performance: The patient bends the thigh joint to the top as far as it can reach, by raising the entire leg to the top, and the difference in the reading of the device is taken between the angle of zero degrees and the angle of maximum bending of the thigh joint.
- Recording: three attempts and the best reading is taken. As in Figure (11)

Figure (11) shows the measurement of the range of motion of the hip joint from supine position

Second: Raising the thigh joint to the top as far as possible from the prone position.

- Name of the test: raising the hip joint to the top as far as possible from the prone position.
- The purpose of the test: measuring the range of motion of the hip joint from the prone position.
- Initial position: the tester takes a prone position on the abdomen and installs the device on the outer side of the thigh joint in a straight line with the spine, as shown in the figure below.
- Description of performance: The tester raises the leg to the top from the thigh joint to the maximum extent it reaches, by raising the whole leg to the top, and the difference in the reading of the device is taken between the angle of zero degrees and the angle of maximum bending of the thigh joint, as in Figure (12).
- Recording: three attempts and the best reading is taken.

Figure (12) shows the measurement of the range of motion of the hip joint from the prone position.

Fifth: Range of motion tests of the affected arm.

A- Measuring the range of motion of the shoulder joint (Zaqair, 2018)

- Name of the test: raising the arms in front high from standing or sitting.
- Objective of the test: measuring the range of motion of the shoulder joint.
- Description of the test: The angle is measured from the sitting position for the patient, as one arm of the johnny meter is installed on the lateral side of the torso and the other end on the medial side of the humerus bone, and when the direction of the thumb is upwards, the patient is asked to raise the arm forward high for the choice of The anterior construction, when measuring the angle of the horizontal dimensions outward in relation to the injured person, and the injured arm is extended at an angle (90) in front of the body, and the two arms of the johnny meter are fixed along the humerus bone, where the first arm of the johnny meter is fixed in front of the body and the second arm is moved with the movement of the arm with its dimensions towards the back in a horizontal manner. As in Figure (13).
- Measurement method: three attempts and the best reading is taken.

Figure (13) Shows the measurement of the range of motion of the shoulder joint

B - Measuring the range of motion of the elbow joint. (Zaqair, 2018):

- Name of the test: An angle test that determines the movement of the elbow joint.
- Objective of the test: measuring the angle that determines the movement of the elbow joint.
- The tools used: 1- The goniometer: It consists of two arms attached at one end because there is a circle divided into degrees (0_180), and there is an indicator on one of the arms as shown in Figure No. (3-14). 2_ Adhesive tape: to fix the tips of the arms of the device on the arm of the injured person.
- Description of the test: The tester stands near the injured person and fixes one of the two arms of the device with adhesive tape on the longitudinal axis of the hummers, parallel to it, and fixes the second arm of the device with adhesive tape parallel to the forearm, so that the arm of the injured person is stretched in its maximum extension (180) degrees, then the patient bends the joint The elbow, by bringing the forearm closer to the humerus, to record an angle that defines the joint.
- Measurement method: one tester has two attempts, and the degree of angle is recorded with the best attempt as shown in Figure (14).

Figure (14) Shows the measurement of the range of motion of the elbow joint.

C - Measuring the range of motion of the wrist joint: (Mohammed et al., 2021):

- Name of the test: flexion and extension of the wrist joint.
- The aim of the test: measuring the range of motion of the wrist joint.
- Description of performance: the tester takes a standing or sitting position on a chair, bends the wrist joint forward with all fingers of the hand bent as far as possible and fixes for two seconds, then stretches back with the hand joined, filming is done from both sides, as in Figure (15).
- Measurement method: The angle formed between the line joining the styloid process of the radius and the head of the second bone of the hand and the line joining the styloid process is measured.

Figure (15) shows the measurement of the range of motion of the wrist joint

Exploratory experience:

Through the researcher visiting the specialized centers for the rehabilitation of patients with simple hemiplegic cerebral palsy in the Al-Salam Center for Rehabilitation of the Disabled, it was confirmed that the equipment necessary to implement the rehabilitation curriculum was available, and the tasks were distributed to the assistant team, which was clarified in Appendix No. (2). Author, therapist, photographer, and recorder was recognized.

- Identify the obstacles, difficulties and errors that may occur during the application of the main experiment.
- Ensure the validity of the devices and tools used and adjust their levels.
- Find out the time required to carry out the tests.
- Identifying the adequacy of the supporting work team in understanding how to implement the main experiment and defining its tasks.

Two experiments were conducted, one day for the physical tests and one day for the EMG test.

Exploratory experience of physical examinations:

The first reconnaissance experiment was conducted on Thursday (10-11-2022).

Exploratory experience of the EMG test.

The second survey experiment was conducted on Sunday (13-11-2022).

Pre-Tests:

A pre-test was done on the first day of rehabilitation treatment, which is recommended by the doctor and for each patient individually. Pre-tests were done according to the patient's ability.

Rehabilitation Curriculum:

After the researcher conducted personal interviews with doctors and rehabilitation therapy staff, whose names and place of work were mentioned in Appendix No. (1). And after taking the directions of the supervisor. And after reviewing most of the scientific sources and previous rehabilitation programs, I prepared a rehabilitation curriculum in line with the research problem to develop the ability, strength, kinetic range, and muscle electrical. For the rehabilitation of patients with simple hemiplegic cerebral palsy. The curriculum was applied (3) times a week implicitly, and for a period of no less than (12) weeks, then the post-tests were conducted. The curriculum consists of (12) weeks (three months). The total number of rehabilitation units is (36). Each rehabilitation unit is (90) minutes long. The number of rehabilitation units in the aquatic environment is (12) units. One unit per week for (90) minutes. As for the rehabilitation units for physical exercises, there are (24) units. Two units per week of (90) minutes. The symmetrical electrical stimulation device was used before physical exercises for (15) minutes. As a warm-up for injured muscles. Some explanations for the rehabilitation curriculum.

- The rehabilitation unit for physical exercises consists of three sections (warm-up, in which the electrical stimulation device is used for a period of (15) minutes for the muscles of the legs and arms. The main section, in which the physical exercises mentioned in Appendix No. (3) are used, and the final section, in which the therapist gives feedback to the injured And try to talk positively with the patient in order to improve his psychological condition, and also talk to the injured person’s family to do the same exercises at home properly.
- The rehabilitation unit in the aquatic environment consists of three sections (warm-up and a

massage is done for a period of (15) minutes before going down to the water basin, the main section and the exercises mentioned in Appendix (4) are done, and the final section is talking to the patient positively in order to improve his psychological condition .

- The exercises used in the curriculum are shown in Appendix (3) and Appendix (4).
- The intensity used in the exercises according to the ability of the injured person.
- The rubber ropes were used after (5) weeks from the start of the curriculum, and the red rope was started with the least resistance ropes, and after two to three weeks the yellow rubber rope was used with medium resistance more intense than the red rope, and after two to three weeks the rubber rope was used Green is more resistant than red and yellow. According to the patient's ability.

Post-tests:

The post-tests were done after the completion of the rehabilitative curriculum, on a special day for each patient separately, and according to the patient's ability. The post-test was taken into account with the same specifications as the pre-test.

Statistical methods: The search data was processed through the Statistical Package for the Social Sciences (SPSS).

Results and discussion:

Presenting, analyzing and discussing the results of the lower extremity tests of the research sample:

Presenting and analyzing the results of the muscle strength test for the lower extremities, both pre and post, for the research sample:

Table (1) Shows the statistical description of the research sample in the strength tests of the lower extremities

Variables		Mean	Sample volume	standard deviation	standard error
strength.thigh.front.muscles	Pre	1.6000	5	.41833	.18708
	Post	17.0000	5	2.73861	1.22474
strength.thigh.front.muscles	Pre	1.9000	5	.41833	.18708
	Post	15.6000	5	1.14018	.50990
strength.muscle.leg	Pre	1.2000	5	.27386	.12247
	Post	18.2000	5	1.30384	.58310

Table (2) shows the results of the (t-test) test for the correlated samples of the research sample in the pre and post-tests of the force measurement test for the lower working muscles

Variables	Mean of differences	Deviation of differences	Standard error of differences	T value calculated	Degree of freedom	Level Sig
strength.thigh.front.muscles	15.40000	2.38223	1.06536	-14.455	4	.000
strength.thigh.front.muscles	13.70000	1.03682	.46368	-29.546	4	.000
strength.muscle.leg	17.00000	1.06066	.47434	-35.839	4	.000

Significant when the significance value ≤ 0.05

Presenting and analyzing the results of the kinetic range test of the pre and post lower extremities of the research sample:

Table (3) shows the statistical description of the research sample in the kinetic range tests of the lower extremities

Variables		Mean	Sample volume	Standard deviation	Standard error
Kinetic range of the knee joint. extension	Pre	149.0000	5	2.00000	.89443
	Post	169.8000	5	2.28035	1.01980
Kinetic range of the knee joint. flexion	Pre	111.6000	5	1.14018	.50990
	Post	83.4000	5	1.14018	.50990
Range of motion of the thigh lying down	Pre	155.4000	5	1.51658	.67823
	Post	120.6000	5	1.67332	.74833
Range of motion of the thigh, supine position	Pre	170.2000	5	2.58844	1.15758
	Post	152.2000	5	1.92354	.86023

Table (4) shows the results of the (t-test) test for the correlated samples of the research sample in the pre and post-tests of the test measuring the range of motion of the lower extremities

Variables	Mean of differences	Deviation of differences	Standard error of differences	T value calculated	Degree of freedom	Level Sig
Kinetic range of the knee joint. extension	-20.80000-	2.77489	1.24097	-16.761-	4	.000
Kinetic range of the knee joint. flexion	28.20000	2.16795	.96954	29.086	4	.000
Range of motion of the thigh lying down	34.80000	1.48324	.66332	52.463	4	.000
Range of motion of the thigh, supine position	18.00000	3.31662	1.48324	12.136	4	.000

Discussion of lower extremity test results:

When returning to the tables of the pre and post-tests of the strength of the thigh muscles of the affected area contained in the tables (1and2) it is clear that the injured in the research sample who applied the rehabilitative exercises used in the center, had developed their muscle strength towards positive development in the post-tests compared to what it was in the pre-tests in Each of the tests of the strength of the muscles of the thigh muscles of the injured working leg, and the researchers attribute the result of the development and superiority of the injured to the positive effect of the gradual approach it is generally known that spinal cord injuries lead to trophic changes and other peripheral disorders, slowing of blood circulation in the extremities of the paralyzed, changes in basic metabolism, and changes in the skeletal system and other tissues require exercises to help stop the progression of pathological changes and lead to regeneration. function construction" (Weiss et al., 1970). Which is based on rehabilitative foundations that are complementary to the other and considered to put each sample separately, which facilitated the process of moving contractions of the knee and foot muscles that face gradual and non-exhausting resistance of the working muscles, which pushes to enhance the work of the nerves in accepting the

physiological reactions of the muscles for the necessary contractions for each difficulty, given that the degree of The resistances are appropriate to determine the intensity of the rehabilitation exercise and to stop when feeling pain or inability, if it is done "Investing the movement factor with graduated resistances in strengthening muscles and improving nerve impulses, which supports the reduction of the load placed on the joint ligaments when resisting loads" (Easa et al., 2022) By virtue of the fact that the resistance on the injured leg required coordination of the work of the muscles surrounding the joint, and it also depends on both neuromuscular control and the movement of bones and joints or fixing them to counter the effect of resistance in the rehabilitation approach, and this was confirmed by. The factors affecting the production of muscle force are determined by the number of excited muscle fibers, the cross-section of the muscle or muscles participating in the performance, the composition of the muscle fibers, the angle of muscle force production, the length and relaxation of the muscle or muscles before contraction, the length of time spent in muscle contraction, and the degree of compatibility The muscles involved in the performance, the emotional state of the player before and during the production of muscle strength, age, gender, and warm-up. (Fadel & Kadem, 2021)

As the researchers took into account the capabilities and capabilities of each injured person, as well as the appropriateness of the repetitions, the duration of the rehabilitation exercise and the type of movement in it, in which the researcher took into account their ability to apply through experimentation and track the degree of pain or inability according to the precautions to avoid damage or aggravation of the injury, as "muscle strengthening came to give It is logical that strengthening the muscles working in the leg will help reduce the burden on the rest of the healthy parts of the body, such as the other leg or the torso, and allow them to generate energy resulting from the burning of carbohydrates and the generation of tactics in case of fatigue, and the progress in rehabilitation was an incentive at the same time to continue the continuation of the exercise And regularly and prevent the loss of panels that are interconnected and reduce the rehabilitation time “The most important goals of paraplegic rehabilitation are to increase strength, improve flexibility, increase endurance or aerobic conditioning, gait training, transfer training and improve posture” (Article, 2008). Rehabilitation in the water helped increase muscle capacity, which had a role in increasing the strengthening of the muscles that help to stabilize the body in the event of its inability to balance, which is the characteristic of these means, which was suitable for the movement of muscles and parts of the body away from the weight of gravity that prevents movement and facilitates weight loss. The continuation of the rehabilitation units after weeks of obtaining strength and increasing movement enabled the injured to use the joints and gradually from easy to difficult. It also reduced the excessive tremors associated with movement, especially since the injury does not allow the muscles to perform the required contractions. And this organization came to plan the rehabilitative exercises by integrating the effect of each of the muscle stimulation, the graduated force, and the aquatic environment in the emergence of this result from the positive effect in the development of the strength of the muscles of the leg’s thigh for the injured, as Hamid Ahmed points out Rehabilitation exercises are considered one of the most effective physiotherapy methods in the treatment of sports injuries through rehabilitative programs developed according to studied scientific foundations. Rehabilitation exercises aim to quickly restore the injured parts to their physical and functional capabilities. Therefore, rehabilitative exercises help to quickly isolate blood pools and accumulations, and work to quickly restore muscles to their functions. (Mohammed et al., 2021)

Ali and Adel "emphasize the principle of gradual resistance on the muscles for the purposes of increasing and developing muscle strength, and various exercises, equipment and devices are used to achieve this." Continuous training based on scientific foundations leads to significant increase in muscle strength and thus an increase in the ability of muscles to contract and relax properly accompanied by an increase in greater recruitment of kinetic units and thus a reasonable increase in force" (Salman & Kadhim, 2022) . This is what is required for rehabilitation, as "the curriculum based on sound scientific foundations has the ability to increase muscle tension, which makes the muscles work with the best possible productivity by stimulating the largest number of muscle fibers, and continuing with these loads makes the muscle increase in strength as a result of the adaptations that occur in these exercises." fiber". The effect of physical exercises leads to a decrease in random nerve signals and increases the efficiency of the locokinetic system, as the nerve signal in the muscle is strengthened in an organized manner, and it stimulates the movement centers in the brain, in addition to its main effect in preventing muscles from atrophy, improving the efficiency of the metabolism process, and raising the elasticity of connective tissues

(Cord & Rehabilitation, n.d.). Referring to the schedule of the pre and post tests of the range of motion of the lower joints of the patients in the cases of extension and flexion mentioned in the previous tables, it is found that the patients who applied the rehabilitative exercises used in the centers had a positive improvement in the angles of the range of motion measured by the goniometer device in the post-tests compared to their level in the tests. Before, and from reviewing the table of post-tests for the research sample in both of these measurements, a clear improvement is evident in the angles of the lower extremities, and the researchers attribute the result of the improvement and superiority achieved by the injured in these two kinetic ranges, to the use of rehabilitative exercises that allow an increase in enabling the injured to increase the pull-up His muscles and according to the muscular work in each movement of the rehabilitation exercises (Zaqair, 2018). As the researchers intended to use stretching and gradation exercises in this work to achieve more than one purpose in one muscle work in order to help the injured in that the method is useful and provides preventive support for the muscle spindles responsible for pulling the muscles and spread in the muscle fibers, which informs the brain that increasing the duration may lead to damage to the tissue according to Its characteristic of localized pain is increased range, the role of the movement by pulling the muscles and stretching the joint and the number of repetitions had a clear effect in increasing the elasticity of the muscles and the ability of the tendons to abduct and adduct in the movement of the joint. An increase in the extension angle of the knee joint and a decrease in the amount of flexion angle is an indication of an increase in muscle elasticity and flexibility. (Kazar & Kadhim, 2020). This positive effect was due to the movements and their speed, which were included in the rehabilitative exercises, in overcoming the internal resistance of the muscles and protecting the joint from the calcification phenomenon that may accompany the affected joints (Aljorani, 2023). This was helped by the development of the level of muscle strength associated with stretching in the results of this research, which developed the kinetic ranges of the joints, as the appearance of their results with this improvement is due to the fact that the exercises used were under the supervision of specialized doctors and therapists with experience in this therapeutic field. The researchers also attribute the increase in the range of motion of the knee and thigh to the fact that the rehabilitative exercises reduced the stiffness that accompanies the lack of use in the muscles and provided a greater opportunity to benefit from muscle relaxation in increasing the range of motion, since the increase in strength may reduce the range of motion and thus lead to a limitation in the movement of the joint And less production of force in the future and not taking advantage of the joint in its natural currency (hmed, M. J. K. and W. S. (2016). This leads to an increase in the inability to move the joint, and the fact that an increase in strength without being accompanied by an increase in the flexibility of the joint and its range of motion will be useless. (Benedetto, 2020) Not relying on movement limitations with wheelchairs or sticks and increasing self-reliance will reduce kinetic limitations and push the joints to continuous movement, and this generates a range of motion that increases with the progress of treatment. (WE & LT, 1991). Moving the joint freely and within its normal range will lead to increased nutrition of the joint, the tendons accompanying it, and the muscles that operate on it, thus allowing it to better exchange food and oxygen with the blood for more blood to pass through it (Steinberg et al., 2000).

Conclusions and Recommendations:

Conclusions:

According to the results achieved by the research, the researcher reached a number of conclusions, which are:

- The early rehabilitative approach is more useful in rehabilitating the muscles that the induction does not reach.
- The use of symmetrical electrical stimulation is better than the use of external stimulation whose intensity is not controlled.
- The succession in using the vocabulary of the rehabilitative curriculum gives a greater opportunity for the brain to regain control over the parts of the body.
- The use of the water basin is very useful in accelerating the rehabilitation process.
- The development of the body parts was in line with the progress of the rehabilitation curriculum, and there was no delay in one part of the body at the expense of another part.
- The rehabilitative approach is useful for both young and old, as it is in line with the capabilities of each individual.
- The continuous encouragement due to the progress of rehabilitation was a catalyst for recovery.
- The regular attendance of the rehabilitation units accelerated the recovery process.

- The early rehabilitative approach prevented the occurrence of muscular atrophy cases in the affected limbs.
- The shorter the age of the injured person, the better the rehabilitation results.
- The rehabilitative approach cannot be isolated from continuing to take the medical treatment recommended by the doctor.

Recommendations:

According to the conclusions, the researcher recommends the following:

- Need to unify the rehabilitation curricula in the Iraqi Ministry of Health and rehabilitation centers.
- Necessity of adhering to medical prescriptions after the injury and then moving to rehabilitation.
- Benefit from research in higher levels of infection.
- Benefiting from the research in applying it to different ages.
- Carrying out similar studies and research on different samples of different ages.
- Putting a satisfactory history for each case and the need to continue to follow it up.
- Developing diagnostic tests to find out the onset of paraplegia and tests for diagnosing complete rehabilitation.

References:

1. Ahmed, M. J. K. and W. S. (2016). Evaluating Training Program Using Physiological and Biochemical, and Physical Indicators On National Artistic Gymnastics League For Men. *Journal of Physical Education*, *28*(3), 116–129. https://jcope.uobaghdad.edu.iq/index.php/jcope/article/view/1064
2. Aljorani, A. (2023). *The Effect of Special Proposed Exercises Using Circuit Style on Some Types of Muscular Strength and Achievement in Disabled Iraqi League Weightlifters*. *1*(1), 75–84. https://jcope.uobaghdad.edu.iq/index.php/jcope/article/view/1366/1185
3. Article, R. (2008). *Rehabilitation of paraplegia*. *11*(1).
4. Benedetto, P. Di. (2020). *Paraplegia and sport From the past to the present*. *January 1999*.
5. Cord, S., & Rehabilitation, I. (n.d.). *SPINAL CORD INJURY REHABILITATION*. *128*.
6. Easa, F. A. W., Shihab, G. M., & Kadhim, M. J. (2022). the Effect of Training Network Training in Two Ways, High Interval Training and Repetition To Develop Speed Endurance Adapt Heart Rate and Achieve 5000 Meters Youth. *Revista Iberoamericana de Psicologia Del Ejercicio y El Deporte*, *17*(4), 239–241.
7. Fadel, G. A., & Kadem, M. J. (2021). Youth and Sports Forums' Administration and Their Relationship with Baghdad's Youth and Sport Directorates Forum Organizational Culture from Workers' Point of View. *Journal of Physical Education*, *33*(3), 1–15. https://doi.org/10.37359/jope.v33(3)2021.1182
8. Kazar, F. H., & Kadhim, M. J. (2020). The Effect of Increasing Rehabilitation Program Using Electric Stimulation On Rehabilitating Knee Joint Working Muscles Due to ACL Tear In Athletes. *Journal of Physical Education*, *32*(3), 14–18. https://doi.org/10.37359/jope.v32(3)2020.1012
9. Mohammed, P., Kadhim, J., Ghadah, P., & Shihab, M. (2021). *The Effect of Using Fast And Direct Cooling after Physical Effort on Some Physiological Variables of Advanced Football Players*. *25*(6), 10020. https://www.proquest.com/openview/fd995719bc359d2e05fa6fe346bed0f6/1?pq-origsite=gscholar&cbl=2031963
10. Salman, S. M., & Kadhim, M. J. (2022). *International Journal of Early Childhood Special Education (INT-JECSE) The effect of special exercises in the rehabilitation of the shoulder muscle for the youth wrestling category Faculty of physical Education and sports Sciences / University of Baghda*. *14*(05). https://doi.org/10.9756/INTJECSE/V14I5.555
11. Steinberg, L. L., Lauro, F. A. A., Sposito, M. M. M., Tufik, S., Mello, M. T., Naffah-Mazzacoratti, M. G., Cavalheiro, E. A., & Silva, A. C. (2000). Catecholamine response to exercise in individuals with different levels of paraplegia. *Brazilian Journal of Medical and Biological Research*, *33*(8), 913–918. https://doi.org/10.1590/S0100-879X2000000800007
12. WE, P., & LT, T. (1991). The weight-bearing upper extremity in women with long term paraplegia. *Paraplegia*, *29*(8), 521–530.
13. Weiss, B. M., Beck, J., & Ph, D. (1970). *Sport as Part of Therapy and Rehabilitation of Paraplegics*. 166–172.
14. Zaqair, M. J. K. and A. A. (2018). The Effect of Sodium Bicarbonate Added To Water On First Class Soccer Players' Pulse After Effort. *Journal of Physical Education*, *30*(2), 454–472. https://jcope.uobaghdad.edu.iq/index.php/jcope/

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Appendix (1)

Rehabilitation Units:

Physical exercises used in the rehabilitation curriculum

No.	Parts	Exercises
1	Arm	Full grip exercise for all four fingers, except for the thumb
2	Arm	Exercise more than half a fist for the four fingers, except for the thumb
3	Arm	Half-fist exercise for all four fingers, except for the thumb
4	Arm	Quarter fist exercise for all four fingers, except for the thumb
5	Arm	Thumb flexion and extension exercise forward and backward
6	Arm	An exercise to raise and lower the palm from the wrist joint
7	Arm	The exercise of moving the palm to the right is an approximation of the body and to the left is an abduction from the body
8	Arm	An exercise to raise and lower the arm from the elbow joint
9	Arm	Hand rotation exercise from the wrist joint to the elbow joint inside and out
10	Arm	An exercise to raise and lower the arm to the side of the shoulder joint
11	Arm	An exercise to raise and lower the arm forward and backward from the shoulder joint
12	Arm	The exercise of placing the arm horizontally parallel to the body, then moving the arm from the shoulder joint to the front of the body and then to the side
13	Arm	Make both the humerus and the forearm perpendicular, then raise the hand from the forearm joint up once and then down again
14	Arm	The exercise of placing a rubber ball in the palm of the hand, and the injured person grips and opens the fingers of the hand
15	Arm	The exercise of placing the hands in front of the body attached one to the other and inserting the hands into the elastic cord (yellow color with least resistance after (6) weeks from the start of the curriculum) and fixing it on the wrist joint, and the patient tries to open the hands to the side
16	Arm	An exercise where the patient carries a dumbbell in the affected arm and tries to raise and lower the arm up and down (the weight is according to the patient's ability)
17	Arm	An exercise to fix a rubber rope on the ground, and the injured person, from a sitting position, lifts the elastic rope forward and upward from the shoulder joint with the outstretched hand

18	Leg	Complete forward and backward toe flexion and extension exercise
19	Leg	Ankle flexion and extension exercise forward and backward
20	Leg	Ankle rotation exercise in and out
21	Leg	Knee flexion and extension exercise
22	Leg	Exercise from a sitting or lying position, the patient pushes a fixed resistance (a wall)
23	Leg	An exercise using a rubber rope from a sitting position with the legs outstretched. The therapist puts the rubber rope on the face of the foot and pulls it towards the patient, and the patient resists the rope in the opposite direction.
24	Leg	An exercise from a sitting position on the chair, the patient raises the leg and fixes it for a period (according to the patient's ability)
25	Leg	Walking up and down a small runway
26	Hip	Exercise to bring the man towards the body
27	Hip	Inward and outward rotation exercise
28	Hip	Exercise using the rubber rope from the lying position, the therapist puts the thighs inside the rubber rope and the patient tries to open the leg to the side
29	Back and abdomen	An exercise from the position of lying on the back, the patient raises the pelvis to the top
30	Back and abdomen	An exercise from the position of lying on the back, the patient opens and closes the arch of the back

Explains the rehabilitation units used in the rehabilitation curriculum

Rehabilitation unit (first + second) for the first week

For physical exercises

- Duration of the rehabilitation unit (90) minutes.
- Warm-up time with the symmetrical electrical stimulation device (15 minutes).
- Duration of the concluding section (9.4) minutes.

No.	performance	Repetition	total performance time	Sets	Rest between sets	Rest between exercise
exercise(1)	5sec	5	20sec	4	6minutes	2minutes
exercise(5)	5sec	5	20sec	4	6minutes	2minutes
Exercise(9)	5sec	5	20sec	4	6minutes	2minutes
Exercise(11)	5sec	5	20sec	4	6minutes	2minutes
Exercise(18)	5sec	5	20sec	4	6minutes	2minutes

Exercise(21)	5sec	5	20sec	4	6minutes	2minutes
Exercise(26)	5sec	5	20sec	4	6minutes	2minutes
Exercise(29)	5sec	5	20sec	4	6minutes	2minutes