

**A rehabilitation program using Aqua exercises to improve the functional efficiency of the knee joint muscles affected by an anterior cruciate ligament tear**

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**Introduction and research problem**

The injured person depends on motor rehabilitation therapy to restore functional ability in the shortest possible time, using methods appropriate to the type and severity of the injury, and this is known as rehabilitation. The importance of rehabilitative exercises is due to two basic goals: preventing various sports injuries and returning the player to the competition arena with the same functional and physical efficiency that he had. It must be done before the injury occurs and as quickly as possible, and the success of the rehabilitation program in the event of injury must take several considerations: understanding the structure and physiological function of the joint and the autoreceptors associated with it and its motor system, the availability of special training that allows the athlete to return to full sporting activity, restoring and improving the athlete's ability without the occurrence or recurrence of the injury ( 5 : 67 ).

The goals of rehabilitation are to increase the rate of healing, control pain, quickly eliminate albumin accumulations within the joint, maintain the range of motion of the joint, maintain the degree of physical fitness of healthy parts of the body, prevent the recurrence of injury in the same area, and help the player return to activity. The specialist, in the shortest possible time, can practice all motor performance requirements, develop skills specific to the sport that the athlete practices, work to maintain the player's psychological state and instill the spirit of competition (3 : 216, 45).

The use of aqua therapeutic exercises in the rehabilitation program has many characteristics, the most important of which are:

- The property of buoyancy in the water makes the body suspended. Therefore, achieving balance is easier and makes the risk of falling less, which gives the patient greater confidence in doing the exercises, as the muscles are weak and cannot carry the weight of the body. Thus, the water carries the body or helps the joint to carry the body and relieve pressure on the body. The joint.
- The density of water is greater than the density of air, which makes its resistance greater, and when the patient performs exercises, muscle strength increases faster than when he exercises in the air ( 1 : 130-131).

Researchers point out that therapeutic exercises are a group of exercises intended to help any organ return to its normal state and carry out its full function. They also work to prevent and treat cases of dysfunction of the affected part by taking care of the manifestations of weakness of some muscles, ligaments and joints through performing development exercises. Muscular strength, joint flexibility, and neuromuscular coordination, as the muscle changes its characteristics and size as the athlete stops training or movement, which changes the circumference and cross-section of the muscle.

Through the work of researchers in the field of rehabilitation of sports injuries, it was found that cruciate ligament surgeries are widespread among players for many reasons, and this is what requires surgical intervention. The player may remain in passive rest before the operation, which weakens the muscle and reduces its efficiency. Therefore, the player's rehabilitation before the operation is concerned with strengthening the anterior femoral muscles as well. Surrounding the knee.

Researchers state that aqua rehabilitation exercises, which provide the injured person with variable resistance, help him maintain and develop physical fitness while reducing pressure on tissues affected by any load, while ensuring that the resistance element is gradually advanced in various activities. It also helps in reducing the intensity of pain and accompanying muscle contraction and increasing flexibility. The range of motion and increased muscle strength of the upper and lower extremities.

By reviewing scientific research and previous studies - to the best of their knowledge - they did not find any studies that focused on rehabilitation programs for the knee joint following surgical intervention to restore the cruciate ligament and joint efficiency, such as the study of " **Bridey-Lee, Lynette Crous, Quinette Louw, Momberg** " (2008) ( 2 ) , the study " **Hyung Lee, Hye Kim** " (2021) ( 4 ) , while they did not find any studies concerned with preparing a rehabilitation program using water exercises for the knee joint before surgical intervention, and this is what urged The researcher prepared this study and its title is: A rehabilitation program using water exercises to improve the functional efficiency of the knee joint muscles.

**Search goal:**

The current research aims to design a rehabilitation program for the muscles of the knee joint affected by a torn anterior cruciate ligament before surgical intervention, and to study its effect on (the strength and circumference of the muscles of the knee joint) .

**Research hypotheses :**

In light of the research objective, the researcher assumes the following :

- There are statistically significant differences between the average ranks of the two measurements before and after rehabilitation (before surgical intervention) for the group under study in functional efficiency variables in favor of the post measurement .
- The percentage change rates differ between the average ranks of the two measurements before and after rehabilitation (before surgical intervention) for the group under study in the functional efficiency variables in favor of the post measurement .

**Search procedures****Research Methodology :**

Due to the nature of the research and to achieve its objectives and hypotheses, the researchers used the experimental method with an experimental design for one group using (pre-post) measurement for it .

**Research population and sample:**

The research population consisted of athletes with a ruptured cruciate ligament who were scheduled to undergo surgical intervention during and who attended motor rehabilitation centers in Minya Governorate for the years 2023/2024. The research sample was chosen intentionally and the basic research sample consisted of (14) athletes with a ruptured cruciate ligament who were scheduled to undergo the intervention. Surgical .

**Rehabilitation program for the knee joint affected by an anterior cruciate ligament tear before surgical intervention**

- The goal of the program: The contribution of rehabilitation exercises to strengthening the leg muscles .
- Time of the rehabilitation program: (6) six weeks before the surgery.
- Number of rehabilitation units: The total number of rehabilitation units is (24) twenty-four units, at a rate of (4) four units per week.
- Training unit time: 40: 60 seconds.
- Stages of the qualification program :
  - The first stage: six rehabilitation units aimed at reducing inflammation and feeling of pain and reducing swelling .

- The second stage: nine rehabilitation units aimed at strengthening the muscles .
- The third stage: nine rehabilitation units aimed at developing muscular balance.

**search tools :****First: Devices and tools:**

- Measure the strength of the knee muscles using a dynamometer.
- Measure circumferences using a tape measure.

**Search steps:****Exploratory study**

The researcher conducted the exploratory study by applying tests of the range of motion of the knee joint, as well as the strength of the muscles surrounding the knee, on the exploratory sample, which consisted of (10) ten injured players, only one of whom was from the same research community and outside the main sample.

**Pre-measurement:**

The researcher conducted a pre-measurement on the research sample in tests of muscle strength surrounding the knee before the start of the experiment, and the measurement was done before applying the rehabilitation program before surgical intervention during the years 2023/2024, and given the long period of application and the small number of sample members and their lack of presence at the same time, this is what forced the researcher to He conducts the experiment for each patient individually, with the need to control the research variables as well as the conditions for applying the measurement before the rehabilitation program before surgical intervention.

**Application of the proposed program:**

The researcher applied the proposed training program to the research sample in terms of the time of the training program as well as the number of rehabilitation units and loads in the stages of the rehabilitation program before surgical intervention, at a rate of (4) four units per week ( Saturday / Monday / Wednesday / Thursday ) according to the following , Before surgery, a 6-week rehabilitation program .

**Dimensional measurement:**

After the research sample completed the implementation of the rehabilitation program before the surgical intervention, the researcher conducted the post-measurement of the research sample in all measurements, as was done in the pre-measurement for all variables and measurements of the research. The data was collected, organized, and tabulated for statistical processing .

**Statistical treatments used:**

The following statistical coefficients were used:

- SMA .
- Mediator .
- standard deviation .
- Correlation coefficient.
- Analysis of variance.
- Torsion coefficient.
- Percentage change.
- Wilcoxon nonbarometric test.
- Nonbarometric Mann-Whitney test.

The researchers accepted a significance level of (0.05, 0.01), and the researchers also used the Spss program to calculate some statistical coefficients.

research results :

Table (1)

The statistical significance of the differences between the average ranks of the two measurements before and after rehabilitation ( before surgical intervention) For the group under study in functional competency variables ( n = 14 )

Variables	Before rehabilitation and before surgical intervention			After rehabilitation and before surgical intervention			Value (Z)	Probability of error
	SMA	Average rank	Total ranks	SMA	Average rank	Total ranks		
Thigh circumference	46.07	0.00	0.00	49.07	7.50	105.00	**3.74	0.000
Calf circumference	35.57	0.00	0.00	36.57	7.50	105.00	**3.74	0.000
Calf muscle strength	1.18	0.00	0.00	18.50	7.50	105.00	**3.30	0.001
Front muscle strength	1.71	0.00	0.00	16.43	7.50	105.00	**3.30	0.001
Back muscle strength	1.64	0.00	0.00	6.57	7.50	105.00	**3.31	0.001

\* Significant at the level of (0.05) \*\* Significant at the level of (0.01)

It is clear from Table (1) that:

- There are statistically significant differences between the average ranks of the two measurements before and after rehabilitation (before surgical intervention) for the group under study in functional efficiency variables for the group under study in functional efficiency variables in favor of the measurement after rehabilitation and before surgical intervention.

Table (2)

Percentage changes between the two measurements before and after rehabilitation (before surgical intervention) For the group under study in functional competency variables ( n = 14 )

Variables	Average before rehabilitation and before surgical intervention	Average after rehabilitation and before surgical intervention	Percentage % change
Thigh circumference	46.07	49.07	%6.51
Calf circumference	35.57	36.57	%2.81
Calf muscle strength	1.18	18.50	%1467.80
Front muscle strength	1.71	16.43	%860.82
Back muscle strength	1.64	6.57	%300.61

It is clear from Table (2) that:

- The percentage change rates between the two measurements before and after rehabilitation (before surgical intervention) for the group under study

in functional efficiency variables ranged between (2.81%: 1467.80%), which indicates the effect of rehabilitation in improving these variables .

The researcher attributes this result to the implementation of the proposed rehabilitation program to prepare the knee joint before surgical intervention. The general goal of the rehabilitation program was to contribute to the rehabilitation exercises in strengthening the leg muscles, which in turn works to reduce the load on the knee joint and also improve the muscle tone of the legs and also the muscle circumference .

The researcher also attributes this improvement to the components of the rehabilitation program, which took (6) six weeks before the surgery, and which consisted of (24) twenty-four rehabilitation units at (4) four units per week. The rehabilitation program consists of three stages :

- The first stage, which aims to reduce inflammation and pain and reduce swelling, is done through water compresses and also a wax bath while keeping the joint immobilized with a compressive ligament or the knee .
- The second stage, which aims to strengthen the muscles, is done by walking in a water basin with a commitment to stabilizing the joint .
- The third stage, which aims to develop muscle balance through dynamic exercises to increase muscle strength .

### **Conclusion**

In light of the research hypothesis, the procedures that were followed, the research sample, and the results of the research, the researcher reached the effectiveness of rehabilitation using water exercises to improve the functional efficiency of the muscles of the knee joint affected by an anterior cruciate ligament tear. This was demonstrated by the presence of statistically significant differences between the average ranks of the two measurements before and after rehabilitation (before surgical intervention). For the group under research in functional efficiency variables .

### **Thanks and appreciation**

The researchers extend their sincere thanks and great appreciation to everyone who contributed to the completion of this work in the most complete manner, especially the experts in the field of motor rehabilitation. The researchers also extend their sincere thanks and great appreciation to the expert arbitrators and also the research sample of athletes in the city of Minya who participated in the application of this research and the time they devoted. And information in order for the research to come out in the desired manner and to be able to achieve the desired goal.



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## Research Summary

### **A rehabilitation program using Aqua exercises to improve the functional efficiency of the knee joint muscles affected by an anterior cruciate ligament tear**

The research aims to study the effect of the rehabilitation program using water exercises to improve the functional efficiency of the muscles of the knee joint affected by an anterior cruciate ligament tear. To achieve the objectives of the research and to test its hypotheses, the researcher used the experimental method, as it is the appropriate method for the nature of the research. A model of experimental designs was used, which is the pre- and post-measurement for one experimental group. The research population consists of athletes. The research population consists of athletes with a torn cruciate ligament who are scheduled to undergo surgical intervention during and who are attending motor rehabilitation centers in Minya Governorate for the years 2023/2024. The research sample was chosen intentionally and the basic research sample consisted of (14) injured athletes. With a cruciate ligament tear and surgical intervention was scheduled, the researcher found the effectiveness of a rehabilitation program using water exercises to improve the functional efficiency of the knee joint muscles affected by an anterior cruciate ligament tear. This was demonstrated by the presence of statistically significant differences between the average ranks of the two measurements before and after rehabilitation (before surgical intervention) for the group. The functional efficiency variables for the group under study were in favor of the measurement after rehabilitation and before surgical intervention, and the percentage changes between the two measurements before and after the rehabilitation program (before surgical intervention) for the group under study in the functional efficiency variables ranged between (2.81%: 1467.80). %), which indicates the effect of qualification in improving these variables .

#### **Key words**

- A rehabilitation program
- Water exercises
- Functional efficiency
- The knee joint
- Anterior cruciate ligament