





The effect of static and dynamic rehabilitation exercises restoring the functional ability of the anterior cruciate ligament after surgical intervention in football players

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Received: 03-08-2024

Publication: 28-10-2024

Abstract

The research aims to prepare rehabilitation exercises to rehabilitate anterior cruciate ligament tear injury for advanced soccer players after surgery. The research problem centered on the scarcity or lack of rehabilitation curricula that rely on the scientific method and experience in the sports field to rehabilitate injured people after completing the treatment course provided by the specialist doctor, who often stay away from rehabilitation because of their fear of it. The researcher used the experimental method by designing one group with two pre- and post-tests. The research community included advanced football players in Baghdad Governorate for the season (2023-2024), where the researcher collected sample members from those with knee joint injuries who had undergone surgery to patch the anterior cruciate ligament. Before starting to implement the study, the researcher conducted a field survey on the clubs and found that there were injuries. The researcher collected the sample members for the period from (12/4/2023) to (2/28/2024), and the number of patients who underwent surgery during that period was (7) patients, whose ages ranged between (23-30) years, and (6) were selected. From them to the research experiment after diagnosing the condition by the specialist doctor, and after conducting pre-tests and applying the exercises to the sample, post-tests were conducted and statistical data were processed and many conclusions were reached, the most important of which is that rehabilitative exercises have a positive effect on the speed of the injured players' return to the field during muscle strengthening. Surrounding the knee joint and improving balance and strengthening the muscles and ligaments surrounding the affected knee joint.

Keywords: Therapeutic Execises . anterior cruciate ligament. Football players



Introduction to the research and its importance:

The number of sports injuries is noticeably increasing as a result of high effort in repetitive sports movements for sports activities that require the performance of sports movements with medium or high intensity, as well as the performance of sudden and strong movements during various playing situations, with the coincidence of some reasons such as the suitability of the stadiums and their floors and neglect in some warm-up exercises and strength exercises that are considered dangerous. A major factor in developing the strength of the muscles and joints of the body and the ligaments surrounding them, as these combined factors lead to repeated and expected injuries, including (rupture of the anterior cruciate ligament) in the knee joint. There are also other causes that are closely related to this injury, especially in the game of football, where the knee joint bears the burden. Many burdens as a result of the high effort required by sports work in the event, including technical errors, which is the deviation of the axis of force from its correct path, which leads to pressure on the knee joint and the occurrence of injury as a result of non-physiological movement when rotating the thigh and torso on the bent leg. Therefore, research is of great importance through the use of exercises. For the muscle groups working on the knee joint during the joint rehabilitation period .

Samiha Khalil Muhammad (2008) mentions that the anterior cruciate ligament is one of the four ligaments that support the knee and that stabilizes the knee and prevents excessive movement in it. It is located inside the knee and connects the shin bone to the thigh bone and prevents the shin bones from sliding forward. It also works to balance the joint, and injury to the cruciate ligaments is a serious problem. It is a common sports injury, representing 20% of knee injuries.

D, Lamb (2004) points out that the level of performance in the sport of football has increased and the effort expended during matches and

during the periods of the sports season has doubled, and the game has come to require a high level of physical and physiological competence, defensively and efficiently so that the player can perform his offensive planning duties throughout the time of the match. The game is also characterized by violence and competition, which requires intense focus when training and preparing the players in a comprehensive way.

No, Ashraf Muhammad Ali Jaber (2001) points out that the motor performance of a football player is not just a set of different skills only, but is the result of many other characteristics that characterize him, whether these characteristics are physical, functional, physical, psychological, or mental, and the lack of one of these characteristics may It affects the skill and tactical performance of the football player and hinders his reaching the highest levels. Muhammad Adel Rushdi (2003) states that football is a physical contact sport, and injury occurs as a result of direct and indirect contact, and this depends on the mechanics of the movement involved. Osama Mustafa Riad states (2002) that the injury varies depending on the nature of performance in the game. For example, it was found that lower extremity injuries in football account for about 69% of all football injuries, and the reason for this is attributed to the continuous use of the lower extremity in football.

Research problem:

Injuries in football are many and frequent, the most common of which are knee joint injuries (rupture of the anterior cruciate ligament), which results directly or indirectly. In order to return the joint to its normal state, it must go through two stages. The first is surgical intervention, which is done through a clinical examination and proper diagnosis of the injury condition. The second stage is the period of rehabilitation of the joint for normal work, which must be built on sound scientific foundations through the use of therapeutic exercises that work to strengthen the muscle groups working on the joint.

Therefore, the researcher sought to solve this problem by developing a set of rehabilitation exercises in a scientifically studied way to rehabilitate this injury by strengthening the muscles surrounding the joint, increasing the range of motion, preserving the muscles from atrophy, and reducing the degree of pain, as well as increasing the stability of the joint, which leads to faster recovery of rehabilitation and the return of the injured player. To the stadium as soon as possible.

research aims:

- 1- Preparing rehabilitation exercises for football players with torn anterior cruciate ligament after surgery.
- 2- Identify the effect of rehabilitation exercises in restoring the functional ability of the anterior cruciate ligament (muscular strength, range of motion) after surgery for advanced football players.
- 3- Identify the effect of rehabilitation exercises in reducing the degree of pain.

Research hypotheses:

- 1- There are statistically significant differences between the results of the pre- and post-tests in the variables of strength and range of motion, in favor of the post-test.
- 2- There are statistically significant differences between the results of the pre- and post-tests in the variable degree of pain, in favor of the post-test.

Research areas:

human sphere: Players of first-class football clubs for applicants in Baghdad for the season (2023–2024) with injuries to the anterior cruciate ligament.

Temporal domain Duration: from 12/1/2024 until 6/20/2024.

Spatial domain: The Specialized Center for Physical Therapy and Physical Rehabilitation in Baghdad Governorate/New Baghdad.

Research methodology and field procedures:

Research Methodology:

The researcher used the experimental method with a one-group design with two pre- and post-tests to suit the nature and problem of the research.

Research population and sample:

Choosing the research community and its sample is one of the important matters in any scientific research, and the correct selection of the research sample is one of the important pillars and factors in the success of the researcher's work when he applies the steps or vocabulary of his research practically, and the process of choosing the sample is closely related to the nature of the community from which the sample is taken, so it came The researcher selected the research population in a deliberate manner, as it was determined by the advanced football players in Baghdad Governorate for the season (2023–2024), where the researcher collected sample members from those with knee joint injuries who had undergone surgery to patch the anterior cruciate ligament. Before starting to implement the study, the researcher conducted a field survey on Clubs and it turned out that there were injuries, and the researcher collected the sample members for the period from (12/4/2023) to (2/28/2024) and the number of

injured people who had surgery during that period was (7) injured people whose ages ranged between (23–30) years. (6) of them were selected to participate in the research experiment after diagnosing the condition by the specialist doctor and excluding (1) injured person, who was not among the appropriate conditions for the research, as they were homogeneous in age, skill and physical level, and in terms of the level of injury, they played in the same level of the game. Football, where the sample was selected according to scientific principles, and the research sample was sequentially according to the time of the surgical operation for the injured person. (2) players were selected from the same research sample for the exploratory experiments. The researcher himself supervised the follow-up of the research sample in terms of their application of the rehabilitative approach. Sample selection conditions: The football player must have torn the anterior cruciate ligament and underwent anterior cruciate ligament reconstruction surgery. The ages of the injured range from (23–30). The injured must have the desire to volunteer to undergo the rehabilitation program. The injured person must not have undergone any previous surgery on the affected knee joint. The injured person must not be subject to any other rehabilitation program during the experiment. Continuation and regularity in the rehabilitation program throughout the duration of the program.

Means of collecting information, devices and tools used in research

Means of collecting information

- Arab and foreign sources.
- International Information Network (Internet).
- Tests and measurement.
- Assistant work team.
- Observation and experimentation.

Devices and tools used in research:

- American-made Dell computer
- (1) Chinese-made electronic medical scale.
- Tape measure 2 meters long.
- (2) Chinese-made electronic stopwatch.
- Dynamo meter device for measuring force.

Field research procedures:

- Define search variables:**

Measurements and tests used in the research:

First: Measuring the muscle strength of the knee joint: (Farhat, 2007)

- **Test name:** Extend the leg forward from the knee joint as strongly as possible from the sitting position.
- **Purpose of the test:** Measuring the maximum strength of the anterior thigh muscles and the knee joint.
- **Primary status:** The injured person takes a sitting position on the chair, and attaches the device to the end of the leg bone connected to the ankle of the injured player, and care is taken to stabilize the injured person's other foot.

Performance description: The injured person extends the knee joint with the maximum possible force, and the device indicator moves in proportion to the maximum constant force of the anterior muscles, and then the device reading is taken. Repeat the same measurement for the other joint.

– **Register:** Three attempts and the best reading is taken to the nearest kilo.

Second: Visual analogue scale to measure the degree of pain (V.A.S.) (Wewers & Lowe. 1990)

Hlt is one of the international standards for measuring the degree of pain and has been adopted in many foreign and Arab countries of the world

The goal of the scale: Measuring the degree of pain

Performance instructions: The patient is given a sheet of paper on which is written a line with a length of (10) cm and divided into (10) degrees. When he moves the affected part, the patient is asked to determine the degree of pain he feels because of the table divided into the sheet.

Calculating grades: The degree of pain is recorded by what the injured person feels when moving the affected part. The degree of zero represents the absence of pain and the degree of (10) represents the maximum pain that the injured person cannot bear.

–Third:Testing the range of motion of the knee joint: (Al-Hazzaa, 2009)

–The range of motion of the knee joint is tested by measuring the angles of the joint using a goniometer, which is a device designed to measure the angles to be measured through the presence of different readings of this device in a way that suits the nature of the sample individuals.

Objective of the test:

–Measuring the angles (range of motion) of extension and flexion of the knee joint.

–Capabilities and tools:

–Goniometer, adhesive tapes.

–Performance Specifications:

–The affected person performs the flexion and extension test to measure the extent of movement of the knee joint in two directions (extension and flexion).

–After that, the laboratory gets up from the prone position after attaching the measuring device (Goniometer) with adhesive tapes so that the angle of the leg joint with the thigh is at an angle of (90°). The patient then moves the joint in both directions (flexion and extension) of the knee joint, and then the values of the angles are extracted.

–Registration method: The angles in both directions (flexion and extension) of the knee joint are recorded after installing the ribs of the (Goinometer) device to the maximum range of motion that the joint can reach without feeling pain.

The two exploratory experiments:

Exploratory experience of tests and tools:

The researcher conducted a exploratory experiment, accompanied by the supporting work team, on (2) injured people from the same research sample At exactly three o'clock in the afternoon on Wednesday, 12/1/2024, it aimed to:

- Knowing the time required to carry out the tests.
- Knowing the efficiency of the assistant work team and assigning duties to them.
- Ensure the validity of the tools and devices used in the research.
- Knowing the suitability of the selected tests for the research sample.
- Identifying the obstacles and negatives that may accompany the performance of the tests and working to overcome them in the main experiment.

The exploratory experiment on the vocabulary of rehabilitation exercises:

The researcher conducted a second exploratory experiment, accompanied by the assistant work team, on (2) injured people from the same research sample At exactly three o'clock in the afternoon on Thursday, December 2, 2024, for the purpose of approving the qualifying exercises in the prepared program, the purpose of which is the following:

- Identify the time taken for the rehabilitation unit and the time for each exercise.
- Identify the obstacles and negatives that occur during the rehabilitation unit and work to overcome them in the main experience.
- The appropriateness of the exercises used in the unit.
- The patient's ability to perform appropriate exercises.
- Ensure the validity of the devices and tools used in the research.

- Know the efficiency of the assistant work team.
- Knowing the time required to implement the rehabilitation unit.

Pretests:

The researcher conducted pre-tests on the research sample for the first and second injured players on Monday, corresponding to January 22, 2024, the third on Saturday, corresponding to February 3, 2024, the fourth and fifth on Tuesday, corresponding to February 20, 2024, and the sixth on Wednesday, Sunday, March 3, 2024, accompanied by a staff. The assistant worked at 3 p.m., after giving the necessary information on how to perform the tests, and the researcher began conducting the tests in the research.

Rehabilitation exercises:

The researcher prepared rehabilitative exercises For injured players who underwent surgery to restore the anterior cruciate ligament, relying on previous Arab and foreign sources, references, research and studies, as well as the opinions of specialists in the interviews he conducted with them. The researcher supervised the rehabilitation exercises and applied them to the injured players under research, as the main experiment began on the day (Wednesday) corresponding to (1/24/2024) and ending on (Saturday) corresponding to (6/1/2024). The qualifying exercises took a period of (12) weeks for each player, with a total of (60) qualifying units, with (5) qualifying units. In one week (Saturday, Sunday, Monday, Wednesday, and Thursday), knowing that the start of performing the exercises after the player reaches the third rehabilitation stage, to conduct special rehabilitation for each injured person by performing the exercises, as the time of the rehabilitation unit ranged from (60–75) minutes.

Conditions that must be taken into account when applying rehabilitation exercises:

- Training the muscles of the corresponding (healthy) limb, even during rest periods.
- Training the muscles of the upper limb and trunk.
- A good warm-up before applying the various rehabilitation units.
- Do not ignore the educational requirements during exercises, such as feeling severe pain.
- Do passive (short) stretching with the help of an athlete whenever possible, as the muscle can produce the greatest possible force whenever the muscle fibers are in their longest state.
- Consider changing the angles of muscle action so that all muscle fibers are developed and thus the muscle can work with full efficiency.
- Taking into account changing the type of muscle contraction because this gives an opportunity to develop all muscle fibers, taking into account that the first period of time begins with fixed isometric contraction in order to avoid the occurrence of any complications such as pain in the knee joint or a tumor in the effusion knee joint.
- The gradual intensity of the load should be taken into account during the four stages so that it is low during the first stage, then use 50% of the maximum weight that the athlete can lift and repeat it for 10 consecutive repetitions with the injured foot at the beginning of the second stage. Then this percentage is increased to 75% at the beginning of the third stage, then it increases to 90. %At the end of the fourth stage and before returning to the field.
- Moving from the first stage to the second stage, based on the results of the post-measurements of the first stage, so that the functional condition of the knee joint returns by no less than 60% compared to the healthy knee joint of the same player, then from the second stage to the

third stage by a percentage of no less than 80%, then from the fourth stage. The final result is a 90% return to the field and competition arena, with the return of all normal functions of the injured knee joint and the muscles working on it as close as possible to the healthy member of the same player.

-Cooling down the injured knee joint immediately after performing the training day, starting at 5:10 a.m., standing with the feet and then with the feet.

-Paying attention to training for the elements of physical fitness, such as flexibility, agility, neuromuscular coordination, endurance, and cyclic breathing, from the beginning of the third stage.

-Paying attention to comprehensive, balanced strengthening of all muscles working on the knee joint, with emphasis on the anterior femoral muscles and the posterior femoral muscles.

-Taking into account individual differences between players, as the program is applied individually and not collectively. The decision for the player to participate in competitions is made by the athlete and the treating physician

-The player continues to exercise physical fitness in general and muscular strength of the anterior and posterior thigh muscles in particular throughout his stay on the field.

-Consult the treating physician in case of any complications that prevent the application of the program.

Posttests:

After completing the application of the qualifying exercises that he prepared, the researcher conducted the post-tests On the research sample for the first and second injured players on Monday 6/5/2024 And the third is on Saturday 11/5/2024 And the fourth and fifth on Tuesday, corresponding to 21/5/2024 And the sixth on Tuesday, corresponding to 28/5/2024 Accompanied by the assistant work staff at exactly 3:00 p.m., in the same manner as (the pre-tests), taking into account the place, time, circumstances, sequence of the pre-tests, the assistant team, and the equipment and tools as much as possible.

Statistical methods:

To process the data obtained, the researcher used the statistical package (SPSS) to obtain the results:

- Arithmetic mean.
- standard deviation.
- Torsion coefficient.
- T-test for correlated and independent samples.
- Pearson correlation coefficient.

- Presentation, analysis and discussion of results:

This chapter includes presenting and analyzing the results of the pre- and post-tests of the research sample, and then discussing them according to scientific references to achieve the research objectives and verify its hypotheses.

3-1 Presenting and analyzing the results of the pre- and post-tests for the variables studied for both feet (healthy and injured).

Table (1) It shows the arithmetic means and standard deviations of the variables studied for the healthy and injured leg

Posttest		Pretest		measru ing unit	Statistical features Variables	
±A	s	±A	s			
4.546	33.33	1.048	18.50	kg	Infected	Muscular strength
0.83	35.80	2.07	32.60	kg	The sound one	
4.656	21	2.786	68.83	of the	Extension	Motor range (affected)
1.63	177.33	3.27	163.50	of the	The bend	
0.629	1.12	0.478	7.125	of the	Degree of pain in the affected leg	

Table (2) It shows the difference of the arithmetic means, the calculated (T) value and the (SIG) value and the significance of the variables under study for the healthy and injured leg

Type of significance	SAY	value (T) Calculated	A F	s q	measru ing unit	Statistical features Variables	
Dal	0.002	6.241	5.036	14.833	kg	Infected	Muscular strength
Dal	0.04	2.997	2.38	3.20	kg	The sound one	
Dal	0.000	19.591	5.98	47.83	degree	Extension	The affected range of motion
Dal	.001	6.83	2.63	13.83	degree	The bend	
Dal	0.005	7.407	1.08	6	degree	Degree of pain	

* Significant at the significance level (0.05) if the error level is ≤ or = (0.05).

3-2 Discussing the results of the pre- and post-tests in the muscular strength test.

Through Tables (1) and (2) it was shown that there are significant differences between the pre-test and the post-test in the variable (muscle strength) for the healthy and injured legs, in favor of the post-tests.

He attributes the researcher These differences among the research sample include the rehabilitative exercises prepared by the researcher and the codification of the exercises in a scientific manner appropriate to the condition of the injured player. The researcher is dealing with a joint subject to surgery, so the muscle becomes weak after the surgery and sometimes muscular atrophy that players suffer from as a result of not moving the affected part, which leads to deficiency. The volume of operation of the muscle groups surrounding the joint, and therefore it is natural for these muscles to suffer from atrophy due to insufficient use, so the researcher used flexibility and strength exercises for the muscles surrounding the knee joint, for example,(Ahmed, A. A. 2024) body weight exercises, resistance exercises, and stretching, for its part, increased the length and flexibility of the contracting muscles to increase The size of the force produced, as it is one of the factors that control muscular force (the state of the muscle before contraction), as Wilmore Costilld (1994) indicates that the more a muscle is able to achieve a greater length (closer to its natural length), the more force it is able to produce. Also, the level of strength of the surrounding muscles develops as a result of working with each of the muscles surrounding the knee joint according to its movement, by applying additional force of gradual difficulty, and this is what (Sari Ahmed and Noma Abdel Razzaq) emphasized: "The necessity of building rehabilitation units based on the ability of the joint muscles as well as the ability to Bear the pain " This is what the researcher did by emphasizing the diversity of

the intensity approved for the rehabilitation exercises in the rehabilitation units, and that the rehabilitation exercises were appropriate for the stamina of the injured players and focused on strengthening the muscles surrounding the knee joint, which in turn led to the rehabilitation of the anterior cruciate ligament injury after surgery and the improvement and increase of the muscular strength of the muscles. Working on the joint, in addition to the use of rubber bands and resistance, which helped increase the muscle strength of the muscles surrounding the knee joint, and this is consistent with the findings of a study. **Walid Hussein** The rehabilitation curriculum includes muscle strength exercises and practicing them regularly and gradually leads to various changes in the muscles, such as increasing the cross-section of the muscle, increasing the size of fast fibers, increasing the size and strength of tendons and ligaments, and the density of blood capillaries (Hassan, 2002), and confirms **(Al-Hazzaa, 2000)** On the importance of muscle strength for health, especially the health of the musculoskeletal system: He adds **(Al-Hazzaa, 2000)** The scientific basis for developing muscular strength is through the two rules of gradualness and increasing load, and any type of resistance can be used to achieve this purpose, whether in the form of free weights, weight training devices, rubber ropes, or exercises that use body weight.

3-2-1 Discussion of the results of the pre- and post-tests in the range of motion test (extension, flexion):

Through Tables (1) and (2) it was shown that there are significant differences between the pre-test and the post-test in the variable range of motion (extension, flexion) of the affected leg, in favor of the post-tests. (Satar, K. 2024)

By reviewing the results, the researcher found that the improvement between the pre-test and post-test led to a noticeable improvement in the extension and flexion test. The researcher attributes this to the rehabilitation exercises that contained different types of methods for developing the range of motion, such as static and dynamic flexibility exercises, and doing these exercises slowly and with the widest range of motion. It helped in obtaining these results, as (obtaining a sufficient amount of flexibility for the muscles, tendons, and ligaments of a particular joint or group of joints in a particular movement or activity depends on the amount and intensity of the exercises performed in a wide range of motion, as well as on the degree of flexibility previously acquired by the individual (Al-Takriti) , 1986).

By reviewing the results, the researcher found that the significant change in the range of motion and the passing of most variables to the minimum ideal range of motion indicates the effectiveness of rehabilitative exercises by working on the affected area because the exercises increase the body's flexibility and activity and increase neuromuscular compatibility. (Issa, F. A. W., Mohaif, S. M., & Kadhim, M. J. 2024)

The researcher believes that the development achieved came as a result of the effectiveness of the rehabilitative exercise vocabulary, which was prepared according to the correct scientific foundations and based on the efficiency of the exercises used in the rehabilitative exercises prepared according to the proposed device for strengthening the muscle

groups surrounding the injured knee joint.(Mousa, A. M., & Kadhim, M. J. 2024)

Ranges of motion are among the very important variables that must be focused on, as the movement of the joint and in different directions represents the entire joint. The researcher attributes these results to the fact that therapeutic exercises led to pain relief to the extent that they enabled the injured to achieve these conditions, as well as for correct use, proper performance, and direct supervision from The researcher accepted these results, as well as the use of the method of diversification and change in rehabilitative exercises, in addition to eliminating the factor of boredom and other psychological factors, and that every increase in the training load in terms of intensity and volume is matched by an increase in the practical ability of the organic systems, ensuring their growth and development (Nassif, 1988).

3-2-2 Discussing the results of the pre- and post-tests in the test measuring the degree of pain for the injured leg:

Through Tables (1) and (2) it was shown that there are significant differences between the pre-test and the post-test in the variable (scale of pain degree) for the injured leg, in favor of the post-tests.

He attributes the researcher These differences in the research sample included the rehabilitation exercises prepared by the researcher to accompany the designed device, and this was confirmed by both **(Fox, 1997)** And**(Bahaa El-Din Ibrahim Salama, 2002)** Flexibility exercises complement rehabilitative exercises, as they make the player feel comfortable and relieve much of the pain he suffers from. This comes by increasing the speed and quantity of blood pushed into the circulation, which works to gradually get rid of the results of the injury, as well as the ability to move with the disappearance of the pain and an increase in muscle strength. And ligaments, and this is confirmed by

(Baker, Webrighta & D.H. Pperrin). In rubber band exercises, they are characterized by alternating contraction and relaxation, and this results in an increase in blood flow and flow to the muscles, which results in an increase and rush of blood within them, and the increase in blood flow increases the elimination of the products of work during training and the results of sports injuries.” Atheer Al–Jumaili adds, “The movement The knee is affected by the pain and swelling that occurs in it, which leads to a loss of efficiency, and this develops if the injured person does not receive appropriate treatment and rehabilitation for the injury, which in turn works to restore the movement mechanics of the knee.”

4–Conclusions and recommendations.

4–1Conclusions:

1–Rehabilitation exercises have a positive effect on the speed of injured players returning to the field by strengthening the muscles surrounding the knee joint.

2–Rehabilitation exercises contributed to reducing the degree of pain and eliminating it, and improving muscle lengthening of the muscles and ligaments surrounding the knee joint.

3–Rehabilitation exercises have a positive effect in increasing the range of motion of the knee joint.

4–2Recommendations:

1–The need for solidarity in the efforts of workers in the medical and sports fields to reach the highest levels of sports and maintain the safety of athletes.

2–Benefiting from rehabilitative exercises in rehabilitating similar sports injuries.

3–It is necessary to infer the degree of pain in all stages of rehabilitation for injured players.

4–Confirm the correct medical diagnosis of the injury.

5–Conduct similar studies on other activities, samples, and levels.

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