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THE ROLE OF A PROPOSED REHABILITATION PROGRAM IN IMPROVING THE FUNCTIONS OF THE KNEE WITH A MEDIAL LIGAMENT TEAR-AN ANALYTIC STUDY OF THE EXPECTED EFFECTS AND RESULTS

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Abstract

The research aims to identify the effect of a proposed rehabilitation program on the knee with a torn ligament. A sample of 20 patients with a torn medial ligament in the Iraqi Sports Medicine Federation was conducted. They were divided into two equal groups in terms of circumference measurements - thickness of the hump and fat, range of motion of the knee joint - static muscle strength. The sabotage group used the proposed rehabilitation program with the infrared method, and the group used the current program with the electrical stimulation method. The research showed that the proposed rehabilitation program and the infrared method led to an increase in the size of the medial lower limb circumferences and an increase in the strength of the muscle groups working on the hip joint, knee joint, and foot joint. Reducing the thickness of the skin and fat layers on the previous muscle groups and increasing the range of motion of the knee joint better than the current program and electrical stimulation. The researcher recommends using the proposed rehabilitation program in the rehabilitation of the knee joint injured by a ligament tear and using infrared rays as a means accompanying the proposed rehabilitation program for the knee joint injured by a ligament tear rehabilitation and using measurements of muscle strength, range of motion, and thickness of the skin and fat layers in continuing to use infrared rays as a means accompanying muscle strength training and range of motion even after the end of the rehabilitation program and conducting more research in the field of rehabilitation by combining means accompanying various injuries to the human body.

Keywords: Rehabilitation program, knee injuries, ligaments and muscles, knee functions.

1-1 Introduction and importance of the research

With the technological development in the sciences of physical education and sports, the science of rehabilitation of sports injuries has occupied a prominent position to solve and treat problems related to sports, raise the level of physical and functional fitness, provide security and safety factors for players, care for the injured and rehabilitate them to quickly return to practicing sports activities with high efficiency in the shortest possible time. (31 (35), (37 (39).

The athlete is exposed to various injuries of different types and degrees of severity as a result of being in a state of continuous competitive activity, whether using tools or without them or by running or jumping and other as a result of physical loads and continuous pressures during sports activities, which increases the possibility of injury in any part of the body. The correct diagnosis of the injury and appropriate rehabilitation of the affected area according to the rehabilitation program that suits the requirements of each sports activity, allows the athlete to quickly return to his normal state and continue to exert effort as well as shorten the period

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of his absence from practice, as many athletes fail to restore the full function of the injured part, which leads to the player being temporarily deprived of practicing sports activity and may be permanently The knee joint is one of the most anatomically vulnerable joints in the body compared to other joints, as its stability depends on the strength of the muscles, ligaments and cartilage. Knee injuries vary in degree from simple to the most serious injury, which keeps the athlete away from competition for a long time. (14) (239) The medial collateral ligament tear is one of the most serious and common injuries, especially among football, basketball, skating, handball, wrestling, and boxing players, due to the inability to practice sports activities that it can cause: (11): 267) The mechanism of the medial collateral ligament tear injury varies. It occurs if the foot is fixed and a bruise is directed against the outer part of the knee, leading to its displacement medially, and when the ball is passed with the sole of the foot forcefully while the ball is fixed by the opponent (competitor), or if a severe rotation occurs to the side, such as movements, a bruise against the outer part of the knee, leading to its displacement medially, and when the ball is released with the sole of the foot, the cutter remains in football (2) (115). We find that a moderate degree of medial collateral ligament tear does not require surgery, but rehabilitation is possible through a standardized program (38: 346-347). With the development of diagnostic methods and accurate identification of the cause of doctors generally agree that rest is necessary in addition to taking anti-inflammatory and anti-muscle tension medications.

1-2 Research's problem

Through the researcher's work in teaching the subject of sports injury rehabilitation in the Department of Physical Education and Sports Sciences at the College of Basic Education, Al-Mustansiriya University, and reviewing the Sports Medicine Union in Baghdad, as well as examining statistics on the need for a proposed rehabilitation program for athletes with medial collateral ligament (MCL) tears, it was found that the current rehabilitation programs for MCL tears of the knee joint primarily focus on strengthening the biceps femoris muscle while neglecting other muscles that control the knee joint. Additionally, there is a continuous change in the physiotherapy methods accompanying the program, a lack of regulation in the training loads used in the rehabilitation program, and a low professional level of the technicians executing the rehabilitation program. This often leads to the deterioration of the patient's condition, failure to fully restore the function of the injured part, and deprives them of temporarily or permanently engaging in sports activities.

Rehabilitation programs for knees with MCL tears take on a new perspective in light of advancements in diagnostic and therapeutic skills, contributing to the increased functional stability of the knee by ensuring balanced muscle development around the affected joint, as well as improving range of motion and endurance, without neglecting other general fitness elements. It is also important to maintain these elements for the healthy leg and the upper limb. Therefore, the researcher believes that proposing a specialized rehabilitation program for the knee joint with an MCL tear is of particular practical and scientific importance. It addresses the problems of athletes temporarily or permanently leaving the field and provides ways for them to return quickly, as close as possible to their pre-injury condition, and participate in various sports activities.

1-3 Research's Aims

- Constructing and standardizing a proposed rehabilitation program for the knee joint with a medial collateral ligament (MCL) tear.
- Determining the effect of the proposed rehabilitation program on circumference measurements, skinfold thickness, the range of motion of the knee joint, and static muscle strength as a result of its application on the experimental group.

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- Trying to identify the amount and percentage of improvement between the pre- and post-measurement for both the experimental group and the control group in the study measurements.

1-4 Research hypotheses:

- There are statistical differences between the pre- and post-measurements in the measurements of the circumferences - thickness of the skin and fat layers - range of motion of the knee joint - static muscle strength as a result of applying the proposed rehabilitation program to the experimental group.
- There are statistical differences between the pre- and post-measurements in the measurements of the circumferences - thickness of the skin and fat layers - range of motion of the knee joint - static muscle strength between the experimental and control groups.
- There is a difference in the amount and percentage of improvement between the pre- and post-measurements for both the experimental and control groups in the study measurements.

1-5 Research areas.

Human field: People with medial ligament tears in the knee joint in the Iraqi Sports Medicine Federation (intermediate degree) and their number was 20 2024/1/30 injured during the period from 2023/1/2 until 2024/4/41

Time field: From 12/15/2023 until Human field: Iraqi Sports Medicine Federation, Baghdad.

1-6 Research methodology: The researcher used the experimental method because it is appropriate to the nature of the research problem.

2.3 Research community and sample

The main experiment was conducted on the research community, which is people with a tear in the medial ligament of the knee joint in the Iraqi Sports Medicine Federation (medium degree), and their number was 20 injured during the period from 1/2/2023 to 1/30/2024. The following conditions were taken into account in selecting the sample: Diagnosis and determination of the injury is the responsibility of a specialist doctor. The initial examination determines the location of the injury through the pathological signs determined by the doctor during the examination, as well as the pain resulting from moving the knee joint in different directions. Confirming the diagnosis of the injury by conducting a computer tomography scan. The sample does not include any people with chronic diseases. Individuals who are not regular in the study are excluded (6 injured were excluded). The average age is from 20-35 years so that their response is faster to qualify.

Figure (1)

Basic variables of the research sample individuals

Group	Experimental		standard	
Variable	N=10		N=10	
	h	R	h	R
Age	24,10	5,74	26,20	2,94
Height	181,20	4,52	180,00	4,76
Weight	81,30	5,81	81,4	5,83

Homogeneity was performed in the two study sample groups in terms of age, height and weight. The researcher found that the two research samples were homogeneous.

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3.3 The methods, devices and tools used in the research
References and Specialized Resources in Sports Rehabilitation
Physical Therapy Tools:
Infrared Radiation Device: Used for therapeutic purposes.
Medical Sterilization Tools: Ensuring hygienic conditions during treatment.
Measurement Instruments:
Medical Scale: For accurate weight measurement.
Stadiometer: For height measurement.
Metal Measuring Tape: For circumference measurements.
Skinfold Caliper: For measuring skinfold thickness and fat layers.
Range of Motion and Muscle Strength Assessment:
Fluxmeter: For measuring joint range of motion.
Dynamometer: For measuring static muscle strength. The best of three attempts is recorded.
These resources and tools are essential for developing and standardizing a comprehensive rehabilitation program for individuals with medial collateral ligament (MCL) tears, ensuring precise assessment and effective treatment.
3-4 Field research procedures:
3-4-1 Determining the physical therapy methods used during the study
3-4-2 Initial design of the proposed rehabilitation program.
3-4-3 Exploratory study.
3-4-4 Distribution of physical loads in the rehabilitation program stages.
3-4-5 Determining the physical therapy methods used during the study
4-3-6 Based on the theoretical analysis of references and scientific research, the following physical therapy methods were selected.
3-4-7 Rehabilitation exercises: They are the basis of the components of the proposed rehabilitation program It aims to provide the injured member with physical fitness support in order to return the injured person to his normal state. The exercises used are divided into:
Pediatric, assisted, and with resistance. When the full range of motion is reached, the exercise load reaches maximum intensity (208:41).
4-8 Infrared rays the researcher used infrared rays as an auxiliary rehabilitation method before performing rehabilitation exercises, as they work to expand and open the capillaries on the surface of the skin, increase metabolism. And reduce the degree of swelling by improving blood flow in the blood vessels and speeding up the building of soft tissue by renewing cells and improving the range of motion of the joints by increasing the sensitivity of protein substances found in connective tissues and bones, which reduces the degree of muscle contraction and contraction and reduces the severity of pain by reducing the degree of excitement of sensory receptors in the skin. (159:18), (47:22) (1892)
3-4-9 The measurements used were determined as follows.
Measure the circumferences of the thigh at 3 inches 80 inches and the leg for the affected limb
and the healthy limb. Measure the thickness of the skin and fat layers in front and behind the thigh, and the leg for the affected limb and the healthy limb, Measure the active and passive range of motion of the knee joint for the affected limb and the healthy limb measure the static muscle strength of the hip joint, knee joint, and foot joint for the limb The affected and the healthy limb (1): 242) 0 (10: (36), (26403630301:39)
4-10- Initial design of the proposed rehabilitation program:
The main objectives of the rehabilitation program:

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1- Balanced development of strength between muscle groups working on the knee joint.
2- Lengthening the muscles and ligaments associated with the joint.
3- Increasing the flexibility of the muscles working on the joint and improving their movement.
4- Improving physical fitness in general.
5- Achieving relaxation to calm the muscle tension associated with the injury, which helps to complete the recovery process. Efficient rehabilitation of the knee joint and return the injured person to his normal state as close as possible.
6- Maintaining the elements of physical fitness for the healthy man.
7- The rehabilitation program was divided into four main stages:
The first stage lasts 3 weeks: This stage begins after the end of the stage critical (acute pain) and aims to work on reducing the feeling of pain while reducing the degree of muscle contraction, improving muscle tone, and preparing the injured person to perform Exercises in the next stage Muscles affected Rectus femoris – Sartorius – Gluteus maximus – Biceps femoris (long head) – Aponeurosis femoris – Adductor minor – Semimembranosus – Vastus medialis –Gemini Ferus gastrocnemius – Rectus abdominis. – Type of exercises used:
Static muscle work exercises (36): 125-222), (38: 348-(359
phase II: 3 weeks.
Objectives:
-1- Increase muscle strengthening.
2- Increase the range of motion of the knee joint to the point of possibility Encouraging the injured to walk.
3- Muscles affected: Albiceps maximus - Rectus femoris - Genius sartorius - Semitendinosus - Semimembranosus Vastus lateralis – Vastus Mediates - Rectus medialis - Biceps femoris - Gastrocnemius - Arcus - Flexor digitorum longus - Extensor digitorum longus – Fibula Metatarsus - Erector spinae - Pectoralis major.
Type of exercises used:
Isometric muscle work exercises (static) Muscle work exercises
Isotonous (7/89) (39) (322), (259-318:38)
Phase III: 3 weeks
- Its objectives:
1- Raising the mechanical efficiency of the knee joint.
2- Performing flexion and extension movements of the knee joint without pain. Gradual strengthening of the muscles that stabilize the knee joint and resist the forces of gravity during the different positions that the body takes.
Muscles affected by the exercises used: Alpinia's minor (anterior fibers) - adductor longus - adductor minimums - rectus femoris - aponeurosis femoris - sartorius - semimembranosus - adductor magnus - popliteus - vastus plantaris - vastus medialis - vastus intermedius - gracilize - soleus - geminate - metatarsal fibula - internal gastrocnemius - erector spinae - triceps brachii.
Type of exercises used:
Isokinetic muscle work Isotonic muscle work (moving). (36) (348-359(,)42()138-140(:38),(232)-125
Phase fourth: lasts for 3 weeks
- Its objectives:
1 - Disappearance of pain in different positions taken by the body.
2 - Return to normal life
3 - Preventing the injury from recurring in another way.

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4- Maintaining the elements of physical fitness for a healthy man.
Muscles affected by the exercises used: Iliolumbar - Pubic - Rectus femoris - Aponeurosis femoris - Sartorius - Median mechanism - Graceful - Adductor longus - Adductor minimus - Biceps femoris. Adductor magnus - Semimembranosus - Semimembranosus pastus - Posture -Rectus lateralis - Median nine - Vastus intermedius - Extensor longus for fingers - Flexor digitorum longus - Tibialis brevis - Soleus – Fibula Metacarpal - Rectus abdominis Oblique abdominal externa - Oblique abdominal Internal - Pectoralis major
Type of exercises used:
- Muscular work against resistance (weights) and isokinetic muscle work (isotonic muscle work). (140 - 138: 12), (348 - 359: 38) -. (20: 316: 528, 6 - (232)10

4-3 -11 Exploratory study

The exploratory study was conducted during the period from 12/20/2023 to 12/24/2023. The number of individuals on whom the exploratory experiment was conducted and individuals from outside the research sample resulted in the following: Modifying the methods of implementing the measurements to suit the nature of the injury (Rehabilitation program implementation individually).
1- Deleting exercises that require high resistance and cause pressure on the area
2- Paying attention to strength exercises without neglecting exercises that lead to flexibility of the injured part. Reaching the most appropriate loads in terms of intensity and volume) with which the injured person begins the stages 3- Reaching the most appropriate rest periods between the exercises used, which ranged between (10 - (20) seconds. 4- Determining the most appropriate rest periods between groups, which reached about .4 Thus, the program became suitable for application to the basic sample. The accompanying means of infrared rays are used at a rate of 15 minutes before each rehabilitation session Throughout the period of using the proposed rehabilitation program, the Iraqi Sports Medicine Federation was chosen to implement and apply the rehabilitation program.

11-4-3 - Distribution of physical loads for the stages of the rehabilitation program:

About 5% of each week for rehabilitation within this stage. The rehabilitation program began with an intensity of 60% of the maximum repetition or time of the group of exercises used at the beginning of the first rehabilitation phase, the intensity was gradually increased by a percentage of Levan. The second rehabilitation phase began with an intensity of the maximum repetition or time of the Caribbean group used at the end of the first rehabilitation phase. The intensity was gradually increased by a percentage of about 5% of each week of rehabilitation within this phase. The third rehabilitation phase began with an intensity of 80% of the maximum repetition or time of the group of exercises used at the end of the second rehabilitation phase. The intensity was gradually increased by a percentage of about 5% of each week of rehabilitation within this phase. The fourth rehabilitation phase began with an intensity of 90% of the maximum repetition or time of the group of exercises used at the end of the third rehabilitation phase. The intensity was gradually increased by a percentage of about 5% of each week of rehabilitation within this phase. The experimental group used the proposed rehabilitation program with the physical therapy method (infrared rays) and the number of sample members was 10 injured. The control group uses the current program with the physical therapy method (electrical stimulation and the number of sample members is 10 injured.

13-4-3 Pre-test:

The researcher conducted the pre-test with the assistance of the assistant research team in the Iraqi Sports Medicine Federation on 12/31/2023 with variables and measurements of the circumferences, the thickness of the skin and fat layers, the range of motion of the knee joint, and measurements of the static muscle strength of the two research groups. It was found that the two research groups were equal to the absence of a significant difference at the level (01). Pre-test for the experimental and control research groups.

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4-3 Main experiment: The research experiment started from 1/2/2024 until3/12/2024
15-4-2 Post-test:
The researcher conducted the post-test on 3/19/2024 and the researcher tried to establish all the procedures of the pre-test as much as possible and help the work team and at the same headquarters of the Iraqi Sports Medicine Federation.
5-3 - Statistical methods used:
Arithmetic mean.
- Standard deviation
- (t) differences.
- Tests
Amount and percentage of improvement %
4- Displaying the results:
1-1-4 Displaying the results of the differences between the pre- and post-measurement of the experimental group in the measurements of the circumferences and the thickness of the skin and fat layers and the range of motion of the knee and the muscle strength of the thigh joint, knee and foot joint.
Table (2)
Arithmetic mean, standard deviation and value (t) of the differences between the pre- and post-measurement of the experimental group in the measurements of the study

Statistical processing		Pre-test		Post-test		Significant	
Measurements		S	A	S	A	Value T	The difference between the two
Peripheries	Hip 3b 6b Leg	11.80 22.60 9.20	1.93 4.22 2.53	2.10 37.40 16.20	2.88 6.96 2.40	**12.76 **16.59 **14.6	8.30 14.80 7
Thickness of the skin layer	Thigh In Front	14.70 15.40	2.41 2.76	7.40 8.70	2.76 1.57	**6.60	7.30 6.70
Fat	Behind The leg	7.50	1.78	4.40	0.97	**6.93 **9.86	3.10
Movement Range Knee hinge	Positive Negative	10.30 16.70	2.06 2.16	20 29	4.29 3.33	**9.20 **24.82	9.70 12.30
Muscle Power	Flexor joint Thigh material Closer Far	12.80 13 15.20 12.90	2.57 1.05 2.20 2.64	23.60 23 26.60 22.70	4.30 1.83 2.67 4.06	**14.26 **16.86 **20.29 **16.54	10.80 10 11.40 9.08
	Flexor joint knee material	15.60 14	2.37 2.67	27.40 25.70	3.63 3.20	**20.58 **26.09	11.80 11.70

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	Flexor joint Foot material	15.40 15.50	3.53 2.99	27.60 27	5.42 3.71	**16.43 **30.86	12.20 11.50

Table 2 indicates a significant difference at the 0.01 level between the pre-test and post-test measurements for the experimental group in the study measurements, favoring the post-test after applying the proposed rehabilitation program.

2-4-2 indicates the differences between the pre and post measurements for the standard groups in this study Arithmetic mean, standard deviation and value (t) of the differences between the pre- and post-measurement of the experimental group in the measurements of the study.

Statistical processing		Pre-test		Post-test		Significant	
Measurements		S	A	S	A	Value T	The difference between the two
Peripheries	Hip 3b 6b Leg	11.90 22.80 9.10	2.18 5.20 2.60	13.70 24.30 2.60	2.21 5.29 2.60	**7.22 **9.00 -	1.80 1.50 1,00
Thickness of the skin layer	Thigh In Front	14.90 15.70	2.81 2.58	13.90 14.60	2.81 2.63	- **11.00	1.00 1.10
Fat	Behind The leg	7.80	1.69	6.80	1.69		1.00
Movement Range Knee hinge	Positive Negative	10.50 16.80	2.37 2.10	11.50 17.80	2.37 2.10	-	1.00 1.00
Muscle Power	Flexor joint Thigh material Closer Far	12.90 13.10 15.40 13.00	3.57 2.64 2.80 3.40	15.10 15.60 17.90 15.50	3.48 2.80 3.07 3.34	**16.50 **15.00 *15,00 **15.00	17.05 2.50 2.50 2.50
	Flexor joint knee material	15.70 14.10	2.54 3.00	18.40 16.80	2.46 2.94	**17.68 **17.68	2,70 2,70
	Flexor joint Foot material	15.50 15.50	2.55 1.51	17.90 18.20	2.28 1.03	**14.70 **12.65	2.40 2.70

Table 3 indicates a significant difference at the 0.01 level between the pre-test and post-test measurements for the experimental group in the study measurements, favoring the pre-test in all research variables except for the circumference of the leg, the thickness of skin and fat layers (front of the thigh and leg), and the range of motion of the knee joint, where no significant differences were observed.

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Table 4
The choice of the (t) test between the experimental group and the control group demonstrates the degree of improvement between the pre-test and post-test measurements.

Statistical processing		Experimental group N= 10		Controlling group N=10		Significant	
Measurements		S	A	S	A	Value T	The difference between the two
Peripheries	Hip 3b 6b Leg	8.30 14.80 7.00	2.06 2.82 1.56	1.80 1.50 1.00	.79 .53 .00	**10.76 **15.73 **14.19	6.5 13.3 6.0
Thickness of the skin layer	Thigh In Front	7.30 6.70	3.50 3.06	1.00 1.10	.00 .32	**6.60 **7.22	6.3 5.6
Fat	Behind The leg	3.10	0.99	1.00	.00	**9.90	2.1
Movement Range Knee hinge	Positive Negative	9.70 12.30	3.33 1.57	1.00 1.00	.00 .00	**9.21 **24.77	8.7 11.3
Muscle Power	Flexor joint Thigh material Closer Far	10.80 10.00 11.40 9.80	2.39 1.70 1.78 1.87	2.20 2.50 2.50 2.50	.42 .53 .53 .53	**13.53 **16.82 **18.51 **18.08	8.6 7.5 8.9 7.3
	Flexor joint knee material	11.80 11.70	1.81 1.42	2.70 2.70	.48 .48	**19.12 **23.67	9.1 9.0
	Flexor joint Foot material	12.20 11.50	2.35 1.18	2.40 2.70	.52 .67	**15.35 **25.24	9.8 8.8

The results in Table 4 clearly demonstrate the superiority of the experimental group over the control group across all variables. The differences were statistically significant at the 0.01 level, favoring the experimental group.

Table (5)
Comparing the study measurements of the injured limb with the healthy limb in the experimental group reveals important insights:

Statistical processing	Experimental group	Controlling group	Significant

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Measurements		S	A	S	A	The difference between the two	Value T
Peripheries	Hip 3b 6b Leg	19.40 37.10 17.10	2.80 6.28 2.96	20.10 37.40 16.20	2.88 6.69 2.04	0.7 0.3 0.09	0.55 0.10 0.79
Thickness of the skin layer	Thigh In Front	7.90 8	2.08 1.15	7.40 8.70	2.76 1.57	0.05 o.07	0.46 1.14
Fat	Behind The leg	3.40	1.26	4.40	0.97	1	1.99
Movement Range Knee hinge	Positive Negative	20.40 30.30	3.50 4	20 29	4.90 3.33	0.04 1.3	0.23 0.79
Muscle Power	Flexor joint Thigh material Closer Far	24.10 23.50 27 24.10	4.89 3.66 3.53 4.61	23.60 23 26.60 22.70	4.30 1.83 2.67 4.06	0.05 0.05 0.04 1.4	0.24 0.39 0.29 0.72
	Flexor joint knee material	27.70 26.10	3.80 3.81	27.40 25.70	3.63 3.20	0.03 0.04	0.18 0.25
	Flexor joint Foot material	28.60 27.50	5.62 4.20	27.60 27	5.42 3.71	1 0.05	0.41 0.28

From table (5) it is clear that there are no significant differences between the measures of the injured limb and the healthy one for the experimental group

Table (6)
Comparing the study measurements of the injured limb with the healthy limb in the controlling group

Statistical processing		Experimental group		Controlling group		Significant	
Measurements		S	A	S	A	The difference between the two	Value T
Peripheries	Hip 3b 6b Leg	232.20 38.80 19.60	6.03 7.54 5.13	13.70 24.30 10.10	2.21 5.29 2.60	9.05 14.5 9.05	**4.68 **4.98 **5.22

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Thickness of the skin layer Fat	Thigh In Front Behind The leg	19.10 8.80 2.40	1.66 1.69 1.07	13.90 14.60 6.80	2.81 2.63 1.69	4.08 5.8 4.4	**4.65 **5.87 **6.96
Movement Range Knee hinge	Positive Negative	19.10 28.10	2.42 4.12	11.50 17.80	2.37 2.10	7.6 10.3	**7.10 **7.04
Muscle Power	Flexor joint Thigh material Closer Far	22 22.10 25.70 22.20	4.71 3.53 4.37 4.66	15.10 15.60 17.90 15.50	3.48 2.80 3.07 3.34	6.9 6.5 7.8 6.7	**3.73 **4.55 **4.62 **3.70
	Flexor joint knee material	26 23.50	2.98 4.09	18.40 16.80	2.46 2.94	7.6 6.7	**6.22 **4.21
	Flexor joint Foot material	26.70 25.80	3.33 3.01	17.90 18.20	2.28 1.03	8.8 7.6	**6.90 **7.55

table (6) it is clear that there are no significant differences between the measures of the injured limb and the healthy one for the controlling group

Table (7)

Showcase the amount and percentages of improvement between the pre- and post-measurement of the experimental and control research communities in the study measurements:

Statistical processing		Experimental group		Controlling group	
Measurements		improvement	percentage	improvement	percentage
Peripheries	Hip 3b 6b Leg	8.30 14.80 7	70.34 65.49 76.09	180. 1.50 1	15.13 6.58 10.99
Thickness of the skin layer Fat	Thigh In Front Behind The leg	7.35 6.70 3.10	49.66 43.51 .4133	1 1.10 1	6.71 7.01 12.82
Movement Range Knee hinge	Positive Negative	9.70 12.30	94.17 73.65	1 1	9.52 8.95
Muscle	Flexor joint	10.80	84.38	2.20	17.05

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Power	Thigh material Closer Far	10 11.40 9.80	76.92 75 9.80	2.20 2.50 75.97	19.08 16.23 19.23
	Flexor joint knee material	11.80 11.70	75.64 11.70	2.70 11.70	17.20 19.15
	Flexor joint Foot material	12.20 11.50	79.22 74.19	2.40 2.70	15.48 17.42

The results in Table 7 clearly demonstrate the superiority of the experimental group over the control group across all variables.

4.2 Discussion of the results.

The results of Table (2) indicate that there is a significant difference at the level (0.01) between the pre- and post-measurement of the experimental group after applying the rehabilitation program applied to the sample, while Table (4) shows the superiority of the experimental group over the control group in all the surrounding measurements. This may be due to the fact that the rehabilitation program includes exercises to strengthen the muscles of the lower extremities in an integrated manner, which is (the quadriceps femoris muscle in a way that contributes to raising the degree of functional stability of the knee through the balanced development of the elements of general physical fitness of the injured person, as well as maintaining the functional status of the healthy leg and upper extremity, unlike the current program, which focused on focusing on one muscle group, which is the rectus femoris muscle, each of (949). (121:10) (41:208) that muscle strength training with each muscle fiber and increasing density work to increase the number and size of the muscle fibers and capillaries in each muscle fiber, which leads to, especially the vastus muscle, the national muscle, and the posterior medial thigh muscle. Increasing the size of the muscle fibers and increasing the circumference of the muscle lower It appears from Table (3) that the arithmetic means of the measurements of the circumferences of the study variables decreased in the pre-measurement compared to the post-measurement of the control group. As for Table (6), it shows the presence of significant differences in favor of the healthy extremity when comparing it to the injured limb of the control group, this may be due to the weakness of the muscle groups of the injured leg as a result of immobilization and lack of movement due to the injury. This is consistent with what was mentioned by (122:28). (35:213), (116:40), (43:210) In that the injury leads to a feeling of pain, which leads to a lack of movement of the muscles working on the joints, and thus avoiding movement of the injured body for a long period, which leads to muscle atrophy and loss of muscle size as a result of fixation, and the thigh rate increases in the muscle circumference and thus in its mass. While Table (7) indicates the superiority of the experimental group over the control group in measurements of circumferences, Table (5) shows the absence of significant differences when comparing the study measurements of the injured limb with the healthy limb of the experimental group, due to what the proposed rehabilitation program includes of various and diverse exercises for fixed muscle forces (isometric) and moving muscle forces (isotonic), which lead to an increase in the physiological section of the muscle and an increase in muscle forces, then an increase in the size of muscle fibers as a result of the increase in fibers resulting from the longitudinal division of the muscle fiber, in addition to the use of the accompanying rehabilitation method that works alongside the rehabilitation exercises in an appropriate manner during the rehabilitation program, and this is consistent with what was indicated by (27:29). The use of a gradual rehabilitation program from one stage to another based

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on continuous and comprehensive evaluation of exercises and the appropriate physical therapy method works to quickly return the athlete to as close as possible to his normal condition before the injury. Table (2) shows the presence of significant differences at the level (0.01) between the pre- and post-test measurements of the experimental group after applying the proposed rehabilitation program, while Table (4) shows the difference between the experimental group and the control group in the measurements of the thickness of the skin and fat layers. This is due to the fact that the proposed rehabilitation program is performed for the purpose of balanced development of the body parts as a whole, and the average physical performance is light to moderate, as the individual consumes about 50% fat and 500 carbohydrates during and after training, in addition to using the appropriate rehabilitation method, which leads to a decrease in the thickness of the skin and fat layers. This is consistent with what was stated by (6: 111) that physical effort leads to the consumption of a large number of calories after training (than before it) during the recovery period.

Table (3) shows an increase in the average thickness of the skin and fat layers in the study variables for the pre-measurements of the control group, while Table (6) indicates the presence of significant differences in favor of the healthy limb when compared to the injured limb of the control group. This may be due to the injury, which in turn led to lack of movement, which led to weakness of the muscles working on the joints of the thigh, knee and foot. As well as the period of immobilization, which led to weakness of muscle strength, which showed a high percentage of thickness of the skin and fat layers in front and behind the thigh and behind the leg. This is consistent with what was reached by (212:12), (498:21) that Increasing the thickness of the skin and fat layers means weakness of the muscles located under the fatty tissue.

While Table (7) indicates the superiority of the experimental group over the control group in measurements of the thickness of the skin and fat layers. Table (5) shows that there were no significant differences when comparing the study measurements of the injured limb with the healthy limb of the experimental group. This is due to the inclusion of the proposed rehabilitation program in exercises aimed at increasing the muscle strength of the muscles working on the thigh, knee and foot joints and developing the general fitness of the injured person, which led to increased energy consumption and the movement of fat in the fat cells in order to provide the muscle cells with energy and thus reduce the body fat stores, unlike the control group, in which the amount and percentage of improvement decreased due to its interest in developing the biceps femoris muscle and neglecting to develop the muscle strength of the thigh and foot joints, in addition to not implementing the training loads of the traditional program and neglecting to develop the general fitness of the injured person's body. This is consistent with what was mentioned and reached by (6: 177) (12: (212) – 81: 16) that the effect of training is evident in. Reducing adipose tissue in the body.

Table (2) shows the presence of significant differences at the level (0.01) of the pre- and post-measurement of the experimental group after applying the proposed rehabilitation program, while Table (4) shows the superiority of the experimental group over the control group in the measurements of the range of motion of the knee joint. This may be due to the effect of the exercises of the proposed rehabilitation program, which included various flexibility training methods from active, passive and compound flexibility exercises, as well as the use of exercises to strengthen the corresponding muscles, and this is consistent with what was indicated by (124:3). (3:4) The range of motion is determined by the strength of the groups.

The muscle groups that are performing the movement and the elasticity of the corresponding muscles, and to develop the range of motion, the strength of the muscle group performing the movement must be developed in addition to improving the muscle group corresponding to it

As for Table (3), it shows an increase in the average thickness of the skin and fat layers in the study variables for the pre-measurements of the control group, while Table (6) indicates the presence of significant differences

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in the healthy limb when compared to the injured limb of the control group. This may be due to the negative effect of the injury on the joint and the muscles working on it, and the swelling and feeling of severe pain when moving the joint, which leads to muscle spasm of the muscles working on it, so movement in the joint decreases in addition to the period of immobilization and the negative effects that accompany it (63-62:34))13428()18929. This is consistent with what was indicated by (43): (2210) that as a result of the injury, muscle spasm occurs due to the severe feeling of pain accompanying the injury, which leads to a reduction in movement in the joint and thus weak muscle contraction. The period of immobilization and immobility also negatively affects the joint in that it leads to a reduction in the range of motion as a result of weak sliding between the surfaces of the bones that make up the joint. It also works to weaken and shorten the muscle fibers, which leads to a decrease and stiffness of movement in the joint after removing the means of fixation.
While Table (7) shows the superiority of the experimental group over the control group in the measurements of the range of motion of the knee joint, Table (5) indicates that there are no significant differences when comparing the measurements of the study of the injured limb with the limb of the experimental group. This is due to the interest in building the proposed rehabilitation program, including all elements of physical fitness and diversity in the use of fixed and mobile viewing methods and standardizing the use of the accompanying rehabilitation means. This is conveyed with each of (15: 295) (20) 172), (122:30) (33:35) that rehabilitation is the restoration of full function (of the injured part in terms of the completion of the elements of physical fitness, including the range of motion and muscle strength, and choosing the appropriate rehabilitation means for the injured person's condition and standardizing its use so that any traces or symptoms of the injury disappear when returning to the normal state, in addition to Using infrared as a suitable medium.
The increased range of motion in the knee joint and the release of heat from the working muscles help in the sliding of the joint surfaces. This aligns with the findings of several studies (19:3; 30:384) that infrared radiation aids in relaxation, pain relief, increased blood supply to the working muscles, muscle temperature elevation, and metabolic rate enhancement, enabling the injured individual to perform movements with ease due to reduced pain intensity, decreased muscle contractions, and improved joint functionality. Consequently, this facilitates an increased range of motion and development of the muscle groups responsible for movement, thereby improving the elasticity of the opposing muscle groups.
Table (2) shows a significant difference at the 0.01 level between the pre-test and post-test measurements for the experimental group after applying the proposed rehabilitation program. Similarly, Table (4) indicates the experimental group's superiority over the control group in muscle strength measurements. The researcher attributes this to the proposed rehabilitation program, which includes isometric muscle strength training during the initial rehabilitation stages, enhancing the static muscle strength of the muscle groups working on the joints of the thigh, knee, and foot. This finding is consistent with studies (8:178; 23:139-145; 24:112; 5:13; 13:141) that suggest strength training using isometric muscle work increases muscle strength without increasing muscle size, thereby developing maximum static and dynamic strength. Moreover, as noted by other researchers (19:297), isometric training is crucial for muscle strength training and forms the foundation for muscle strength development. The observed superiority is also due to dynamic muscle work training during different rehabilitation stages, improving the muscle strength of the muscles working on the thigh, knee, and foot joints through a progressive and advanced resistance training program.
This finding is supported by research (23:139-145; 177:25) that indicates significant increases in muscle strength through isometric and dynamic muscle work training with varying exercise intensity, duration, and repetitions. Advanced resistance training enhances muscle strength and endurance. Table (3) shows a decrease in the pre-test mean values for the control group variables. Table (6) reveals significant differences favoring the uninjured limb compared to the injured limb in the control group, likely due to immobilization and the

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resulting reduced movement, leading to decreased muscle strength of the muscles working on the thigh, knee, and foot joints. This is consistent with findings (26:18; 34:12) that injuries and immobilization lead to muscle fiber atrophy and, consequently, decreased muscle strength in the muscles around the joints.

Table (7) demonstrates the experimental group's superiority over the control group in muscle strength measurements of the knee joint. Conversely, Table (5) shows no significant differences when comparing the injured limb to the uninjured limb in the experimental group. This is attributed to the use of isometric and dynamic (isokinetic) training through equipment like stationary bikes and treadmills, which facilitate high-resistance exercises at a constant speed regardless of varying resistances. Integrating these rehabilitation methods allows for pain-free exercise performance, aligning with findings (37:451; 19:297; 227:15) that isometric and dynamic muscle work training significantly increases muscle strength with varying exercise intensities and repetitions. Isokinetic training enables muscles to contract at a constant speed even with changing resistances, and the appropriate accompanying rehabilitation methods play a vital role in enhancing the strength of the muscle groups working on different body parts, particularly the knee joint, and building their full strength.

Additionally, using infrared radiation as a complementary rehabilitation method helps mitigate the negative effects of the injury, relaxes the muscles, alleviates pain and contractions, and increases muscle temperature. The rate of blood flow in the blood vessels, which allows for the performance of static and dynamic muscle strength exercises without feeling pain. This is consistent with (2: 189), (16: 190 (20: 138) (38: 96) that the infrared method helped expand and open the capillaries and blood circulation in the blood vessels on the surface of the skin and increase metabolism, and build soft tissue to regenerate cells. Micra in performing static and dynamic muscle strength exercises. And reducing the intensity of pain by reducing the degree of excitement of sensory receptors in the skin and allowing the start of

We are the muscle strength of the working muscles. From this, it is clear that the proposed rehabilitation program was better than the current program in terms of the hip, knee and foot joints, as well as maintaining the functional status of the healthy limb, in addition to the positive effect of the accompanying rehabilitation method, while the current program only focused on developing the muscle strength of the biceps femoris muscle, although it is necessary to strengthen and develop the balanced muscle strength of the front and back muscles of the thigh and the calf muscle, which forms a collar Protecting the knee joint helps to maintain Stability of the knee joint in its various movements

Conclusions: The following is within the limits of the research sample and the tools used and in light of the results that were reached: We conclude

-1- The exercises of the proposed rehabilitation program and the accompanying Tamil means of infrared rays are performed

-2- Increase the size of the lower limb circumferences -

-3- Increase the strength of the muscle group working on the hip joint, knee joint, and foot joint

4- Decrease the thickness of the skin and fat layers on the previous muscle groups

-5 Increase the range of motion of the knee joint better than the current program and electrical stimulation: Recommendations Based on the results of the study, the researcher recommends the following:

1- Use the proposed rehabilitation program in the rehabilitation of the knee joint injured by a ruptured ligament

2- Use infrared rays as a means accompanying the exercises of the proposed rehabilitation program The knee joint injured by a ruptured ligament

-3- Rehabilitation using muscle strength measurements, central range, and thickness of the skin and fat layers in

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-4- Continue using infrared rays as a means accompanying strength training Muscle And range of motion even after the end of the rehabilitation program.
5 - Conducting more research in the field of rehabilitation by combining the means accompanying the various injuries of the human body.