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Rehabilitative exercises and therapeutic methods and their effect on the distribution of body weight on the feet and some physical characteristics to correct the injury of the anterior cruciate ligament in football players

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Abstract
The cruciate ligament injuries involving the knee joint are among the difficult and common issues in the field of injuries for athletes, which occur through sprains or frictions in the stadiums with the opponent or fall during play, and therefore they will be deprived from practicing their lives, sports activities and physical exercises in a natural manner. The importance of this study and its current output is one of the attempts and scientific experiments to know those effects of some methods included in rehabilitation exercises and some therapeutic methods before and after the cruciate ligament severing surgery. Regards to The research fields included the human field, and they are athletes with a total rupture of the cruciate ligament in the knee joint, and their number (10) with a complete rupture of the cruciate ligament " football players, in the stadiums of the Ministry of Youth and Sports in Iraq - Maysan, private swimming pools in Maysan, and a stadium Distinguished High School in the Ministry of Education / Maysan, and specified in the temporal domain by the duration of the domain Time: (7/10/2021) to (10/2/2022). The researchers concluded:
Rehabilitative exercises and pre-operative treatment methods had an effective role in getting rid of pain and swelling.
Balance exercises are very important to improve the role of sensory receptors in the knee joint, as the exercises showed a clear improvement in balance.

Keywords: Rehabilitation exercises, physical characteristics, cruciate ligament

Introduction
Rehabilitation exercises are the best way, or the best method, to return the injured to his physical practices in sports activities, and it is also one of the good ways and methods for returning injured athletes to their normal pre-injury situation, for example, with job performance, level, and physical efficiency as well, and when any injury occurs in any part For the athlete, it will naturally lead to an obstruction in his physical activity, exactly in the affected part for a period of time, and therefore there will be weakness in the functional performance of the affected part, and the most appropriate way to restore the functional and physical performance of this injured person is the method of rehabilitation represented by rehabilitation exercises. (Hans S, 1991) [3] The knee joint is one of the most vulnerable parts of the body to injury, and it may be from an anatomical point of view or through other reasons, and the injury to the anterior cruciate ligament is one of the common injuries in football players. And the importance of the current study, and its goal is how to return the injured cruciate ligament to its normal position without problems, according to approved scientific bases, and scientific tests according to each stage of rehabilitation, the scientific addition in this study consists of several things. Before the surgery, it has a clear role to facilitate the surgery, get a lot of movements, maintain the strength of the anterior thigh muscles, control pain, control the tumor, obtain full range of motion for the joint, improve balance, reduce stiffness in the joint, benefit after the surgery And during the rehabilitation of the anterior cruciate ligament of football players.

Research problem: The current study is one of the scientific attempts to study the effect of some exercises, and the different treatment methods in the injury of the cruciate ligament before and after the surgery, and that the research problem lies in several points, which is the stage of rehabilitation before the surgery of the anterior cruciate ligament, which is complete cutting, as the stage before the surgery has a clear role to facilitate the surgery, getting a lot From the movements, maintaining the strength of the anterior thigh muscles, controlling pain, controlling the tumor, obtaining full range of motion for the joint, improving balance, reducing stiffness in the joint. And the prevalence of knee joint injury, complete severing of the anterior cruciate ligament for football players, and the inability of the injured to reach full recovery for those who underwent surgery, as well as the failure to choose the appropriate rehabilitation exercises for each stage of rehabilitation, how to perform them, and their frequency and comfort, as the researchers were able to: The use of electrical stimulation in a scientific way. The researchers believe that there are some shortcomings in defining the criteria for moving from one stage to the stages of rehabilitation, and even not setting criteria for returning to competition, as setting some criteria for the stage of returning to competition, and not setting up a program for running during the rehabilitation period, the process of complete cutting of the cruciate ligament for football players**.**

Research aims

- Preparing different exercises and means of treatment to rehabilitate the injured in the anterior cruciate ligament of the knee joint for football players.
- Knowing the differences between the pre- and post-operative tests in some physical characteristics and the distribution of body weight on the foot
- Research hypotheses
- Knowing the differences between the pre- and post-operative tests in (some physical characteristics and the distribution of body weight on the foot).

Research areas

- Human field: soccer players with complete cruciate ligament rupture
- front and their ages ranged (20-25) Sunni, and from the men in Maysan Governorate - Iraq the field Location: The stadiums of the Ministry of Youth and Sports in Iraq - Maysan, swimming pool
- The special school in Maysan, and the distinguished high school playground in the Ministry of Education / Maysan Al- Majal Time: (7/10/2021) to (10/2/2022).

Research methodology and field procedures

Research community

The researchers used the experimental method for its relevance to the nature of the problem to be solved, which is an attempt to control all the variables, and the basic factors. 25) years old, knowing that the members of the sample were football players and one experimental group for the tribal and remote measurements, and their number was (10) with a complete rupture of the cruciate ligament, and the injury was diagnosed with a group of specialized doctors, and it is of the third type.

Tests and measurements used in the research

First: The name of the body weight distribution test on the feet from stability, the pretest was done in the third week after surgery: (Kyritsis, (2016) [16].

Measurement purpose: To measure the force distribution on the foot.

Tools Used: Dynafoot.

Second: Measuring the kinetic range (flexion - tide) (Bashar, 2018) [1].

Physical exams

The name of the Illinois test (Polyvios 2016) [9] the pretest was done in the fifth month after the surgery

Purpose of the test: Fitness

1. T test. (Polyvios 2016) [8] the pretest was done in the fifth month after surgery
2. The purpose of the test: agility.
3. The four jump tests as a criterion for the athlete's return to play (Polyvios, 2016) [9]
4. Test name: One-jump test
5. Test name: One-legged triple jump (Polyvios 2016) [8]
6. Test name: 6m jump.

Fifth: Balance test (standing on the affected leg). (Randall, 2017) [10].

1. Field actions
2. Tribal tests

The researchers conducted the tests and measurements under study before starting the first rehabilitation that precedes the surgery on the injured and the rehabilitation lasted for a period of (a month and a half), and after the surgery for a period of 6 months, and this period was determined according to the exercises given in this period after consulting experts, and therapists, and rehabilitation specialists, as during this period the patient is accustomed to walking with a crutch by touching the ground with the injured foot and trying to walk and lean on the injured foot, and flexion.

Qualifying exercises

The proposed qualifying exercises were designed based on scientific studies and research and analysis of their content to find out the differences and shortcomings when designing and applying them. The program was divided into several stages, including before the surgery. After that, the period before the surgery was a month and a half By 30 rehabilitation units, and after the surgery 6 months, and by 120 rehabilitation units, and it consisted of a simple treatment phase, which consisted of 4-6 weeks, according to the condition of each injured, where they go to the swimming pool after lifting the thread and stiffening the wound. As for the intermediate stage, three days in the gym for strengthening 5 days a week and the qualifying unit time ranges from 60-90 d (Sunday, Tuesday, Thursday) and (Monday, Wednesday) in the swimming pool with a time of 60 d, and the re-competition phase is at the rate of (5) qualifying units per week, and the duration of each unit is (90-100 minutes, and according to the patient's ability and ability to perform, as it is not possible to determine the time of the rehabilitation unit due to the psychological state that the patient is going through. The researchers used therapeutic methods such as electrical stimulation, the American-made Compax device, which was used before the surgery. Four electrodes were distributed On

the origin and tone of the muscles, the device works on stimulating the muscles in an excellent manner with a time of (10-20) minutes programmed by the manufacturer of the device and it was used in the first week after the surgery, and at a rate of three sessions per week between one day and another. The device was also worked on during weight training in the gym because the device contains many things, namely warm-up, massage, rehabilitation, training. The researchers used ice after the surgery, and after the end of each qualifying session for a period of 15 minutes, and the ice must be placed correctly, that is, covering all The knee joint with ice was placed in a well-tight plastic bag, and therefore to prevent water from reaching the surgery, the researchers also used Kinezio tapes, and placed them above the knee by 5 cm, and therefore to reduce the tumor.

Detailed stages of rehabilitation exercises before and after the surgery

Pre-operative stage (6 weeks (30 rehabilitation units, unit time 60-65 minutes)

Objectives

- Elimination of pain and swelling.
- Regain control of the usual walking pattern.
- Reducing joint stiffness.
- Strengthening the quadriceps muscle in order to facilitate the surgery.
- Improve balance.
- Obtain the degree of flexion 120 degrees.
- Maintain a range of movements such as walking, flexing, and stretching
- The most important methods used in rehabilitation before surgery:
- Electrical muscle stimulation.
- Ice.
- Isometric exercises.
- Flexibility exercises to not joint stiffness.
- Moving exercises to the level of pain.

Post-tests

The researchers conducted the same post-tests that after the end of the rehabilitation program in each stage individually for each victim in the tribal tests on different dates because the sample was not available at the same time, and the tests were done on different days, but in sequence for the same pre-tests, and the researchers were committed when implementing the tests to provide the conditions and requirements The same time, place, tools used, and applied method of the tests.

Statistical processors:

- The researcher used the SPSS statistical package.
- Standard deviation.
- Arithmetic mean.
- A repeated measures analysis of variance.
- T- test for correlated samples.
- LSD test.
- Variance analysis.
- **What did this study add?**

Developing the muscle group for some auxiliary parts of the body that have a role in the injury area

No significant atrophy of the surrounding muscles after the cruciate ligament cut.

The use of rehabilitation exercises before the surgery has a role in improving and developing the surrounding muscle strength working on the knee joint.

The use of rehabilitation programs before the surgery leads to the development of rehabilitation periods after the surgery by performing work and maintaining strength ratios, lengthening the muscles, and preserving complete atrophy in the area surrounding the injury, and the area of injury as well**.**

Presentation, analysis and discussion of the results:

4-8 Presentation, analysis and discussion of the results of the measurement of kinematic range (tide) for the tests before and after the surgery of the research sample:

Table 1: A table showing the calculated value for measuring the kinetic range (extension) in the tests (pre- before the surgery, post before the surgery, pre- after the surgery, post- after the surgery) for the research sample

T	Variables	Sum of squares	Degree of freedom	Mean squares	(F) computed value	Indication level
1	Kinetic Range (extension) Measurement	6291.031	3	2097.010	131.509	0.000
	error limit	430.537	36	15.946		

Table 2: LSD Table showing comparisons in kinetic range (before the surgery, post- before the surgery, pre- after the surgery, after thesurgery) (the extension) for the research sample

T	Variables	Intermediate tests		Arithmetic mean		Median difference	Standard error	Indication
1	Kinematic range (extension)	Pre - before the surgery	Post - before the surgery	148.42	177.18	-28.760*	2.470	0.000
		Pre - before the surgery	Pre - after the surgery	148.42	159.61	-11.190*	2.335	0.001
		pre- before the surgery	Post - after the surgery	148.42	178.42	-30000*	2.285	0.000
		Post - before the surgery	Pre - after the surgery	177.18	159.61	17.570*	0.740	0.000
		Post - before the surgery	Post - after the surgery	177.18	178.42	-1.240	1.028	0.258
		Pre - after the surgery	Post - after the surgery	159.61	178.42	-18,810*	0.869	0.000

4-9 Presentation, analysis and discussion of the results of the measurement of kinematic range (flexion) for the tests before and after the surgery of the research sample:

Table 3: It shows the calculated value for measuring the kinetic range (flexion) in the tests (before the surgery, post- before the surgery,pre- after the surgery, post- after the surgery) for the research sample

T	Variables	Sum of squares	Degree of freedom	Mean squares	(F) computed value	Indication level
1	Range of motion (flexion)	106826.467	3	35608.822	5127,452	0.000
	Error limit	187.508	36	6.945		

Table 4: LSD Table showing the value of comparisons between the results of the flexural range of motion (before the surgery, post- before the surgery, pre- after the surgery, after the surgery after the surgery

T	Variables	Intermediate tests		Arithmetic mean		Median difference	Standard error	Indication
1	range of motion (flexion)	Pre - before the surgery	Post - before the surgery	41.46	144.9	-103.440 *	1.691	0.000
		Pre - before the surgery	Pre - after the surgery	41.46	40.36	1.100	0.639	0.119
		Pre - before the surgery	Post - after the surgery	41.46	143.62	-102.160 *	1.152	0.000
		Post - before the surgery	Pre - after the surgery	144.9	40.36	104.540 *	1.396	0.000
		Post - before the surgery	Post - after the surgery	144.9	143.62	1.280	0.989	0.228
		Pre - after the surgery	Post - after the surgery	40.36	145.62	-103.260 *	0.901	0.000

The hypothesis of the range of motion (flexion - extension) has been achieved from the above values, and this is due to the effect of the rehabilitation program prepared by the researchers in terms of therapeutic methods and exercises used in flexion and extension from the first day of the surgical surgery, which had an effective role in improving the range of motion of the knee joint. The researchers attribute this improvement due to the researcher's use of range-of- motion exercises immediately after the surgery, in order to get rid of the blood pools and adhesions inside the joint that occurred as a result of injury or as a result of the surgical surgery, and this was through the rehabilitation program that included several different and varied exercises, as the researchers emphasized To implement the exercise correctly through certain angles for each stage of rehabilitation, and gradation according to the improvement of the patient and the existing pain, and the researchers also used fixed muscle stretching exercises that work to increase the elasticity of the muscles. Surrounding the joint and the strength of the tendons and ligaments, where it improved The nature of muscle work in contraction and relaxation, which increases the release of the angles of the motor range, and that "increasing the motor range means an improvement in the elasticity of the muscles and ligaments surrounding the joint, as well as an improvement in the neuromuscular work in controlling the work of the sensors responsible for providing sensory information to the brain about this range." ()

This was confirmed by Magdy and Cook 1996 that passive range-of-motion exercises should be started immediately and with the help of the therapist, in addition to positive range-of-motion exercises because of their great importance in eliminating joint pain and reducing swelling. (Magdi, 1996)

4-11 Presentation, analysis and discussion of the results of measuring the distribution of body weight on the foot for the tests after the surgery of the research sample:

Table 5: It shows the differences between the tribal and remote tests in the values of the distribution of force on the injured foot / before – after dynafoot device

T	Variables	Measuring unit	Pretest		Post test		Calculated t value	Indication
			s	p	S	p		
1	big finger	Kg	23,520	5.447	37.807	10.250	6.497	0.000
2	fingers 2-3	Kg	26,166	6.946	43.011	10.54	6.980	0.000
3	fingers 5-4	Kg	29.008	7.719	44.345	10.145	6.174	0.000
4	medial side of the midfoot	Kg	32.144	9.409	45,794	13,864	5.791	0.000
5	Lateral side of the midfoot	Kg	31,430	11.611	.48,874	16,084	7.849	0.000
6	medial side of the heel	Kg	28.224	6.108	37.787	13.909	3.141	0.012
7	Lateral side of the heel	Kg	28.714	6.103	42,234	11.104	3.744	0.005

From Table (5), the hypothesis of distributing body weight on the foot has been fulfilled. The reason for this is due to the presence of exercises starting from the first stage. The weight of the body is distributed on the affected side, and this is done gradually through the gradation from easy to difficult from the first week after the surgery, a certain percentage is distributed On the affected side in order to gradually improve the walking pattern and alert and stimulate the sensory receptors, as the rehabilitative exercises applied to the injured who underwent an anterior cruciate ligament implantation and by applying pressure to the injured leg developed the body's ability to balance, and renew the dysfunctional functions in the affected foot by stimulating the sensory and motor system On distributing the mass and increasing the injured man's ability to bear the mass in a gradual and codified manner through rehabilitation exercises, and the therapeutic methods used affected the improvement of the distribution of body weight on the feet in a good way. Muscles lead to an increase in muscle strength and an increase in the strength of the knee joint "ligaments, muscles and their tendons affect the stability of the joint by cohesioning the end of the joint bones with each other, strong ligaments and muscles increase the stability of the joint" (Susan, 2014).

4-12 Presentation and analysis of the results and discussion of the equilibrium measurement of the tests after the surgery of the research sample:

Table 6: T shows the differences between the pre- and post-operative tests in the values of the postoperative equilibrium test

	Measuring unit	Variable	Pretest		Post test		T value	Indication level
			The middle	Deviation	The middle	Deviation		
1	the second	balance	8.300	2.759	100.200	41,722	6.920	0.000

It is evident from Table (6) that there are significant statistically significant differences in the balance variable. The reason for this effect is due to the rehabilitation program that included balance exercises, which began in the first stage of the rehabilitation program. In the success of the athlete's return to the field, and the restoration of joint stability, and not only muscular strength and range of motion exercises, and this was confirmed by the study of Kevin *et al*. (2017) [4], which seeks to identify recent developments in the rehabilitation of the cruciate ligament. The study showed that

the current rehabilitation programs are not based only on Muscular strength exercises, but also on neuromuscular compatibility exercises and sensory mode receptors to provide an alert to the nervous system so that the athlete can restore the dynamic stability required in sports competition (Kevin, 2017) [4], where researchers emphasize the activation and stimulation of the deep sensory receptors system by using advanced balance exercises that can achieve excellent positive results and benefit from them during the stages of the rehabilitation program and rely on them to move from one stage to another, and researchers use modern balance exercises, including standing on the balance ball with eyes closed, standing on the balance ball and closing the eyes and throwing the ball to the injured person who is trying to catch it. Exercises to stimulate the deep sensory receptors located in the tendons, muscles, and joints, and balance is achieved by strengthening the muscles surrounding the affected joint, and this was confirmed in the rehabilitation program. It must be taken care of, and emphasized within the rehabilitation programs.

4-13 Presentation and analysis of the results and discussion of the measurement of jump tests for tests after the surgery of the research sample:

Table 7: T value shows the differences between the pre and posttests in the jump test battery values

T	Variables	Measruing unit	Healthy man		Injured man		Calculated t value	Indication	Difference ratio
			s	p	s	p			
1	One jump	Meter	150.300	23.022	143.500	23.210	4.477	0.002	95.476
2	Three jumps	Meter	4.830	0.558	4.510	0.441	5.779	0.000	93.375
3	Leg jumping to the right and left	Meter	3.189	0.284	3.035	0.325	2.305	0.047	95.171
4	Jumping with one leg for a distance of 6 metres	A second	4,390	0.412	4.890	0.569	2.694	0.025	89.775

4-14 Presentation and analysis of measurement results Agility: Illinois - T for the tests before and after the surgery of the research sample:

Table 8: T shows the differences between the pre- and post-operative tests in the values of the postoperative agility test

T	Variables	Measruing unit	Pretest		Post test		Calculated t value	Indication
			S	p	s	p		
1	For agility after surgery t - test time	A second	18.145	1.484	11,055	0.755	15,462	0.000
2	Illinois agility test the test is applied in the fifth month after surgery	A second	24,398	0.600	15,790	0.543	39,278	0.000

Through the above tables

The hypothesis of agility was achieved due to the effect of the rehabilitation program, which contained a lot of agility exercises, which contributed to returning the athlete to his normal position and practicing any sports activity without any problems in the affected joint, as the exercises helped the player change direction, jogging, sudden stop and rotation with the ball Or without a ball, as the researchers put these exercises according to what he sees in the playing situations inside the stadium in order for the injured to be imprinted and in line with what is happening from inside the stadium. (2016) (Polyvios Kyritsis, Erik Witvrouw, and Philippe) [9], which emphasized the need to set specific criteria for the athlete's return to the field (Polyvios, 2016) [8]. Mufti Ibrahim 2013 states that the performance of football requires the player's speed of movement to certain directions for very short distances that do not exceed one meter, followed by the direction quickly to one of the sides for a short distance also, not exceeding one meter as well, Movements that require a high degree of correct timing, fluidity, accuracy and correct timing, which in its entirety are agility (Mufti, 2013),This is what the researchers took in the agility training within the training program, where most of the playing situations that occur inside the field of sudden stopping, or joining a colleague and running with the ball, and without the ball, the researchers emphasize the performance of agility exercises in the last stages of the qualifying exercises.

Supplement of the rehabilitation program before the surgery: (first week) the time of the rehabilitation unit: 45-60 minutes (10 minutes stimulation)

The goal of this stage: Improving the range of motion of the stiff joint 2- Improving and restoring balance and walking 3- Obtaining a degree of flexion of 120 degrees 4- Developing the movements of the leg

T	Qualifying exercises	Repetition	Time	Rest between repetitions	Notes
1	From a long sitting position, the patient contracts and relaxes the quadriceps quickly	15-20	3-4	60 sec - 120 sec	Stimulation = 10 d
2	From a lying position, the injured person raises the injured leg (up, down) in a straight shape while leaning and steadily on the other leg	20-15	3-4	120 sec	
3	The casualty is lying on the right side with lifting and moving (the injured leg)	20-15	3-4	120 sec	
4	From a prone position, the casualty should raise the (injured leg) upwards	20-15	3-4	120sec-180sec	
5	From a lying position, the casualty should raise the (injured leg) to the top	20-15	3-4	120-180 sec	
6	From a sitting position, the casualty should pull the (injured leg) as far as possible	20-15	3-4	60 sec - 120 sec	
7	From a long sitting position, the patient (moves the ankle) (back, front) with the rubber bands	1	5 d	60 seconds	
8	From a prone position, he should raise (the knees) out of the bed	10-15	3-4	60 sec - 120 sec	

Supplement to the rehabilitation program after surgery: (first week) Rehabilitation unit time: 60-75 min (20 minutes stimulation)

The goal of this stage: 1- Improving the range of motion of the stiff joint 2- Improving and restoring balance and walking 3- Doing exercises daily (2-3 times) 4- Developing the movements of the leg 5- Reducing the swelling caused by the surgery

T	Qualifying exercises	Repetition	Time	Rest between repetitions	Notes
1	From a long sitting position, the patient contracts and relaxes the quadriceps quickly	10-15	3-4	60sec -180sec	Stimulation = 20 d
2	From a lying position, the injured person raises the injured leg (up, down) in a straight shape while leaning and steadily on the other leg	10-15	4-5	180-240 sec	
3	The casualty is lying on the right side with lifting and moving (the injured leg)	6-9	4-5	180-240 sec	
4	From a prone position, the casualty should raise the (injured leg) upwards	10-20	3-4	120sec-180sec	
5	From a lying position, the casualty should raise the (injured leg) to the top	25-35	3-4	120-180 sec	
6	From a sitting position, the casualty should pull the (injured leg) as far as possible	10-20	3-4	120-180 sec	
7	From a long sitting position, the patient (moves the ankle) (back, front) with the rubber bands	10-20	5 d	60 seconds	
8	From a prone position, he should raise (the knees) out of the bed	10-20	3-4	120sec-180sec	
9	Move (patella) right, left, down, up	10-15	1-2	60 seconds	

Conclusions

In light of the research results achieved on the basis of measurements, tests and data processing statistically, the researchers reached the following conclusions:

- Rehabilitative exercises and pre-operative treatment methods had an effective role in getting rid of pain and swelling.
- Balance exercises are very important to improve the role of sensory receptors in the knee joint, as the exercises showed a clear improvement in balance.
- Knee joint range-of-motion exercises before the surgery, and then led to the full return of the range of motion (flexion-extension).
- The agility and muscle strength exercises, and according to each stage of rehabilitation, to develop all the muscles working on the joint affected the return of the joint to its strength before injury.
- The rehabilitation exercises led to a good distribution of force on the feet.

Recommendations

Through the research, the researchers recommend the following:

- The need to conduct future studies on setting criteria for returning to play.
- Paying attention to the pre-operative program because it has an effective role in the rehabilitation process
- Attention must be paid to the angles of performing the exercise.
- Focusing on the rehabilitation programs containingrange-of-motion exercises and distributing body weight on the foot immediately after the surgery.
- The use of physical therapy means, the most important of which is ice from the first day of the surgery

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