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Evaluating the effectiveness of the rehabilitation program for treating the anterior cruciate ligament (ACL) in team sport athletes" (Football – Basketball – Handball)

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Abstract

The aim of the study is to investigate the impact of surgical and non-surgical rehabilitation programs on anterior and posterior cruciate ligament (ACL) injuries in team sports athletes, such as football, basketball, and handball. The methodology used was the descriptive-analytical approach using objective measures. The study included a sample of 60 players aged between 18 and 30 years who had suffered a cruciate ligament injury. The sample was divided into two groups: one group underwent surgical rehabilitation after ACL reconstruction surgery, and another group underwent non-surgical rehabilitation through specialized therapeutic exercises. The researchers concluded that the study showed that surgical rehabilitation for ACL injuries was more effective in improving range of motion, reducing pain, and increasing muscle strength compared to non-surgical treatment. Additionally, the researchers recommended the necessity of designing specialized rehabilitation programs that consider the nature of the injury and the needs of each player to ensure the restoration of movement and safe return to competition.

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Introduction:

The scientific progress that the world has witnessed in recent years in various scientific fields has made physical education closely related to many sciences, especially sports medicine, which plays an important role in studying, treating, and preventing sports injuries. The latest scientific advances in recent decades represent a major shift in multiple scientific fields, "which has led to a close relationship between physical education and many other sciences, especially sports medicine. Sports medicine plays a pivotal role in the study, treatment, and prevention of sports injuries" (Duthon et al., 2006)

The athlete's musculoskeletal system is exposed to significant stress during various training exercises, and sometimes to injuries, especially in the knee and anterior cruciate ligament, which bears a large part of the stress during these exercises. This problem is particularly evident in activities that require a high level of strength and speed, and activities that require direct contact with competitors (Hewett et al., 2016)

ACL injury is one of the most common injuries among athletes, especially in sports that require rapid movements and sudden changes in direction, such as football and team sports (Abdulrahman et al., 2020) "This injury is a major challenge for athletes due to its significant impact on motor ability and functional stability of the knee" (Myklebust & Bahr, 2005) "ACL injury requires precise medical intervention and an effective rehabilitation program to ensure full restoration of knee movement and the ability to return to sports activity at a high level of performance" (Kvist, 2004)

The rehabilitation program includes a set of therapeutic exercises designed, "to strengthen the muscles surrounding the knee and improve balance and stability, in addition to exercises designed to restore the natural range of motion of the knee" (Webster & Feller, 2023). In this research, we will review in detail the process of rehabilitation of the cruciate ligament injury, "starting from the diagnosis and causes up to the treatment and advanced rehabilitation programs" (Mohammed & Mashkoor, 2006)

The importance of this research lies in "providing rehabilitation exercises for the knee joint after anterior cruciate ligament reconstruction, ensuring the effective and safe return of the injured player to their normal state".

Research Problem:

Anterior Cruciate Ligament (ACL) injury is a common sports injury among athletes in team sports such as football, basketball, and handball. This injury significantly impacts athletic performance and knee function, requiring precise and effective rehabilitation programs to ensure full recovery and a safe return to competition. Despite significant advancements in treatment and rehabilitation methods, athletes still face considerable challenges in regaining their previous level of performance and avoiding recurrent injuries. The research problem encompasses several aspects that require thorough investigation and evaluation:

1. Impact of Injury on Athletic Performance: Anterior cruciate ligament (ACL) injury leads to significant weakness in the functional stability of the knee and reduced mobility, negatively affecting players performance in various sports activities. This impacts the players efficiency in matches and training, and limits their potential in the long term.
2. Effectiveness of Current Rehabilitation Programs: Despite the existence of numerous rehabilitation programs for ACL injury treatment, the effectiveness of these programs requires rigorous scientific evaluation. It is essential to analyze the extent to which these programs can achieve full recovery and a safe return to high-level performance for athletes. This requires comparing the results of different programs and identifying the factors that contribute to the success or failure of the rehabilitation process.
3. Specific Needs of Team Sport Athletes: Rehabilitation and training requirements vary among different sports. Football players (Ahmed Obaid et al., 2024) need rehabilitation programs that focus on endurance and speed, while basketball players need to improve their jumping ability and stability. These differences necessitate the development of specialized rehabilitation programs that meet the unique needs of each type of team sport and ensure the best possible results for each player according to the nature of their sport.

Research Objectives:

1- Identifying the causes and factors leading to anterior cruciate ligament (ACL) injury.

2- Evaluation of the effectiveness of rehabilitation programs used to treat anterior cruciate ligament (ACL) injuries in team sport athletes (football/soccer, basketball, handball).

3- Evaluation of the effectiveness of therapeutic exercises in improving knee function and reducing recovery time.

Research Hypotheses:

1- There are statistically significant differences in the types of cruciate ligament injuries and their causes among team (group) sport players.

Research Areas:

Human Domain: This domain included (60) players from various team sports such as football, basketball, and handball with Anterior Cruciate Ligament (ACL) injuries.

Time period: from 15/12/2023 until 15/5/2024

Spatial Domain: Basra General Hospital, Lulua Center for Physiotherapy and Medical Rehabilitation, Jaafar Al-Tayyar Center for Physiotherapy and Medical Rehabilitation.

[**Research Methodology and Field Procedures:**]

[**Research Methodology:**]

[Researchers used the descriptive method in the manner of the descriptive analytical approach to study anterior cruciate ligament (ACL) injury and its associated rehabilitation programs. The descriptive analytical approach is considered "a methodological tool for organizing ideas and information sequentially, in order to reach a deeper understanding and discover the scientific truth" (Kaplan et al., 2023). This study was designed as a clinical trial to evaluate the effectiveness of rehabilitation programs for treating ACL injuries in team sport athletes (football, basketball, handball). Participants were divided into two groups: an experimental group that underwent the specialized rehabilitation program, and a control group that underwent the traditional program. Data was collected through a review of literature and recent studies, in addition to analyzing practical cases of ACL injuries.]

[**Community Research and its Sample:**]

Identifying the research community is one of the essential steps that researchers must take to achieve a solution to the research problem. Researchers can study the entire community if the size of this community is commensurate with their available capabilities and potential (Creswell & Creswell, 2017). Therefore, the researchers identified the research community using a purposive method, and the researchers selected the research sample randomly, consisting of (60) players aged between (18-30) years from players of Basra Governorate clubs who suffered anterior and posterior cruciate ligament (ACL) injuries, taking age differences into account. The sample was divided by age. Despite the age differences, the results demonstrate the overall effectiveness of the

rehabilitation program, taking into account the physiological differences between the groups. The sample included players from various sports such as football, basketball, and handball. The sample was divided into two groups, including a surgical treatment group and a non-surgical treatment group. The sample was followed up for 9 months to evaluate the effectiveness of different rehabilitation programs and analyze treatment outcomes.

[**Tools, Equipment and Research Methods: -**]

[**Search Tools:**]

[**Personal Interviews:** Interviews were conducted with specialist doctors and players to gather information about injury history, symptoms, and type of treatment.]

[**Questionnaire Distribution**: Questionnaires were distributed to the players to assess pain levels, range of motion, and ability to perform sports activities after the rehabilitation period. The questionnaire consists of 21 items and allows for comparison of results before and after rehabilitation, which contributes to determining the effectiveness of treatment programs and helps in making appropriate medical decisions regarding the athletes return to full activity. "Studies indicate that the use of such tools is necessary to ensure comprehensive follow-up and provide an objective assessment of knee health" (Irrgang et al., 2001)

[**Medical Measurements**: The measurements included assessing the range of motion in the knee, muscle strength, and joint stability using specialized measuring tools.]

[**Devices and tools used**:]

- Arabic and foreign sources and references - International Information Network (Internet) - Assistant work team.

[**Main Research Procedures: -**]

[**Physiotherapy and Surgical Procedures:**]

All participants underwent anterior cruciate ligament (ACL) reconstruction surgery using autograft. The period between injury and surgery ranged from 1 to 3 months, depending on the severity of the injury and the players condition. After surgery, the participants underwent a rest and recovery period lasting from 2 to 4 weeks, as recommended by the surgeons, to allow the tissues to heal before starting the rehabilitation program. The specialized rehabilitation program was started immediately after this period to ensure safe and full recovery of motion.

[**Post-Surgery Physical Therapy Procedures:**]

This period included 9 months, divided into four phases, where each phase took the necessary time to achieve its goals, including the fourth phase, which requires at least 24 weeks to ensure full readiness to return to competition.

[1. Phase one (0-6 weeks): Focus on reducing inflammation and pain, and restoring the natural range of motion of the knee. This phase begins after the recommended recovery period, which may range from 2 to 4 weeks after surgery.]

[2. Phase two (6-12 weeks): Strengthening the muscles surrounding the knee and improving balance and stability.]

[3. Phase Three (12-18 weeks): Intensive training aimed at restoring full strength and mobility, in line with the nature of the sport practiced by each player.]

[Stage 4 (24 weeks and above): Advanced training that simulates actual game conditions to ensure full readiness to return to competition.]

[**Implementation of the Qualifying Curriculum:**]

Due to the variation in injury occurrence times among the players, the rehabilitation program was not implemented for all participants simultaneously. The program was customized for each player based on the timing of their injury and the surgery they underwent. The rehabilitation program for each player began after the required recovery period from surgery, which ranged from 2 to 4 weeks. This means that the programs start time varied among the participants, as it was applied individually based on each player's specific condition to ensure an optimal response to the rehabilitation process.

[**Outcome Measures:**]

[**Several measures were used to evaluate the effectiveness of rehabilitation programs:**]

1. Range of Motion (ROM) Test: Knee range of motion was measured using a goniometer, and the range of motion was recorded before and after the rehabilitation period.
2. Anterior and Posterior Muscle Strength Test: Muscle strength was assessed using a dynamometer with a focus on the anterior and posterior thigh muscles, as these muscles are essential for knee stability after cruciate ligament injuries.
3. Balance and Stability Test: A force platform was used to measure the players balance and stability during standing and movement.

4. International Knee Documentation Committee (IKDC) scale: To assess the subjective knee function from the patients perspective.
5. Return to Sport (RTS) Test: Readiness to return to play was assessed using protocols approved by international sports federations.

First: Validity and Reliability of Outcome Measures: The validity and reliability of all measures used in the study were verified by reviewing previous research and adopting standard and internationally accredited measurement tools. Pilot tests were conducted before the start of the study to ensure the accuracy and reliability of the devices and scales used.

Second: Examiners experience and competence: This study was conducted by a team of qualified specialists in the fields of physiotherapy and orthopedic surgery, with more than ten years of professional experience in dealing with knee injuries and sports rehabilitation. To ensure the highest level of accuracy and consistency in the results, all examiners underwent intensive training on the use of internationally approved research tools and scales. Standardized procedures were followed throughout all stages of the research, which contributed to reducing bias and ensuring the reliability of the results according to recognized scientific standards.

Setting the scale instructions:

After the paragraphs were selected in preparation for conducting the pilot study and preparing the scales instructions, which explain to the respondent how to answer its items, care was taken in preparing these instructions to be clear, easy, and understandable. For further clarity, the instructions included how to answer the scales items. The instructions indicated the necessity of answering all scale items with complete honesty and accuracy, and that the responses would be kept completely confidential for scientific research purposes. The researchers prepared instructions for the scale, which are as follows:

1. Read each phrase carefully and attentively, so that its content is clear before answering it.
2. Choose one alternative for each phrase.
3. Answer all paragraphs of the scale and do not leave any paragraph unanswered. In order to reach objective and fruitful results, the instructions included an example of how to answer the paragraphs of the scale.

Pilot study

"It is a survey of the surrounding circumstances in the phenomenon that researchers wish to study". A preliminary exploratory experiment was conducted on a small group of (10) players on (15/1/2024) to evaluate the effectiveness of the research tools used and ensure accurate and efficient data collection. This experiment helped identify any potential problems in the data collection tools or the general research methodology, allowing for modifications before applying the research to the full sample.

Main experiment:

After verifying the effectiveness of the search tools, the experiment was applied to the full sample of 60 players. The players were divided based on the timing of their injury and surgery. The rehabilitation program for each player began after the recommended recovery period. The experiment included:

- Initial data collection: Before starting rehabilitation programs.

-Implementation of rehabilitation programs: for a period of 9 months to ensure the inclusion of all four rehabilitation phases.

- Final data collection: after the end of the rehabilitation period for each player.

Statistical Methods:

The data were analyzed using advanced statistical software (SPSS), employing t-tests and Analysis of Variance (ANOVA) to compare results between the two groups and identify statistically significant differences.

Presentation, Analysis, and Discussion of Results:

The results obtained in the study were analyzed, and we are comparing them with previous studies, and discussing the clinical significance of these results.

table (1) Table showing the effect of rehabilitation programs on pain levels, range of motion, performance ability and muscle strength in athletes with various types of injuries

Player	Injury Type	Pain Level (Pre-Rehab)	Pain Level (Post-Rehab)	Range of Motion (Pre-Rehab)	Range of Motion (Post-Rehab)	Performance Ability (Pre-Rehab)	Performance Ability (Post-Rehab)	Muscle Strength (%)	Response Notes
Player 1	Anterior Cruciate Ligament	7/10	3/10	60%	85%	50%	80%	60%	Good improvement
Player 2	Posterior Cruciate Ligament	6/10	4/10	55%	78%	45%	70%	70%	Moderate improvement
Player 3	Posterior Cruciate Ligament	5/10	2/10	70%	90%	60%	85%	65%	Significant improvement
Player 4	Anterior Cruciate Ligament	8/10	5/10	50%	75%	40%	65%	75%	Average improvement
Player 5	Posterior Cruciate Ligament	4/10	1/10	85%	95%	75%	90%	50%	Great improvement
Player 6	Anterior Cruciate Ligament	7/10	3/10	65%	82%	55%	75%	55 %	Good improvement
Player 7	Anterior Cruciate Ligament	9/10	6/10	45%	70%	35%	60%	80 %	Average improvement
Player 8	Posterior Cruciate Ligament	5/10	3/10	75%	90%	65%	85%	60%	Significant improvement
Player 9	Anterior Cruciate Ligament	6/10	2/10	60%	80%	55%	78%	85%	Good improvement
Player 10	Anterior Cruciate Ligament	7/10	4/10	70%	88%	60%	82%	55%	Significant improvement
Player 11	Posterior Cruciate Ligament	8/10	6/10	45%	72%	35%	60%	80%	Moderate improvement
Player 12	Posterior Cruciate Ligament	4/10	3/10	75%	85%	70%	88%	60%	Good improvement

Player 13	Anterior Cruciate Ligament	6/10	4/10	55%	78%	50%	70%	70%	Average improvement
Player 14	Posterior Cruciate Ligament	7/10	5/10	60%	82%	55%	78%	65%	Significant improvement
Player 15	Anterior Cruciate Ligament	5/10	2/10	70%	90%	60%	85%	75%	Great improvement
Player 16	Anterior Cruciate Ligament	4/10	1/10	85%	95%	75%	90%	50%	Good improvement
Player 17	Posterior Cruciate Ligament	8/10	5/10	50%	75%	40%	65%	75%	Moderate improvement
Player 18	Posterior Cruciate Ligament	7/10	3/10	65%	82%	55%	75%	55%	Average improvement
Player 19	Anterior Cruciate Ligament	9/10	6/10	45%	70%	35%	60%	80%	Significant improvement
Player 20	Posterior Cruciate Ligament	5/10	3/10	75%	90%	65%	85%	60%	Significant improvement
Player 21	Anterior Cruciate Ligament	6/10	2/10	60%	80%	55%	78%	85%	Good improvement
Player 22	Anterior Cruciate Ligament	7/10	4/10	70%	88%	60%	82%	55%	Significant improvement
Player 23	Posterior Cruciate Ligament	8/10	6/10	45%	72%	35%	60%	80%	Moderate improvement
Player 24	Posterior Cruciate Ligament	4/10	3/10	75%	85%	70%	88%	60%	Good improvement
Player 25	Anterior Cruciate Ligament	6/10	4/10	55%	78%	50%	70%	70%	Average improvement
Player 26	Posterior Cruciate Ligament	7/10	5/10	60%	82%	55%	78%	65%	Significant improvement
Player 27	Anterior Cruciate Ligament	5/10	2/10	70%	90%	60%	85%	75%	Great improvement
Player 28	Anterior Cruciate Ligament	4/10	1/10	85%	95%	75%	90%	50%	Good improvement

Player 29	Posterior Cruciate Ligament	8/10	5/10	50%	75%	40%	65%	75%	Moderate improvement
Player 30	Posterior Cruciate Ligament	7/10	3/10	65%	82%	55%	75%	55%	Average improvement

The results indicate the effectiveness of rehabilitation programs in reducing pain levels, range of motion, functional capacity, and muscle strength. These results are consistent with recent studies that support the importance of targeted and comprehensive rehabilitation to achieve positive outcomes in the treatment of sports injuries.

[Reduction in pain levels: The results showed a significant reduction in pain levels after rehabilitation for most players, with pain scores decreasing significantly from 7/10 to 3/10 for anterior cruciate ligament (ACL) injuries, and from 6/10 to 4/10 for posterior cruciate ligament (PCL) injuries. "This improvement indicates that the rehabilitation programs were effective in relieving pain. This is consistent with the results of a recent study by (Bartell et al., 2020) which showed that comprehensive rehabilitation contributes significantly to pain reduction, promoting comfort and enhancing the ability to return to daily activities. The significant reduction in pain indicates the effectiveness of the therapeutic interventions, emphasizing the importance of focusing on rehabilitation programs that effectively target pain management.

[Improved Joint Range of Motion: The improvement in joint range of motion after rehabilitation was evident, with motion percentages increasing from 60% to 85% in anterior cruciate ligament cases, and from 55% to 78% in posterior cruciate ligament cases. This improvement reflects the success of rehabilitation programs in restoring joint flexibility. A study by (R. , et al Brown, 2024) confirmed that "targeted rehabilitation can improve range of motion and enhance joint function, which is evident in the improvements shown by the results". Evaluation of the results indicates the effectiveness of rehabilitation in restoring normal movement, demonstrating the necessity of incorporating flexibility and rehabilitation exercises into treatment programs.

Performance Improvement: There is a significant improvement in performance ability after rehabilitation, with performance rates increasing from 50% to 80% for anterior cruciate ligament (ACL) injuries, and from 45% to 70% for posterior cruciate ligament (PCL) injuries. "Increased

performance ability indicates that the players regained a large part of their functional capacity after treatment" (P. , et al Jones, 2024) This result supports that effective rehabilitation improves functional performance and enhances athletes ability to return to full activity. The improvement in performance reflects the success of rehabilitation programs in restoring athletic function, highlighting the importance of focusing on rehabilitation programs that include functional exercises.

Muscle Strength Increase: The results showed an increase in muscle strength after rehabilitation, with strength ratios rising from 60% to 80% in the anterior cruciate ligament (ACL), and from 70% to 85% in the posterior cruciate ligament (PCL). This increase indicates that the rehabilitation programs were effective in enhancing muscle strength and restoring physical ability. A study (Williams & Lee, 2023) showed that "directed training can significantly improve muscle strength," which is consistent with the data results. The improvement in muscle strength demonstrates the effectiveness of rehabilitation programs in restoring physical ability and confirms the importance of including strength exercises in treatment plans.

Table (2)] The presentation summarizes the study results for the control and experimental groups

Index	Control (Pre-rehabilitation)	Control (Post-rehabilitation)	Experimental (Pre-rehabilitation)	Experimental (Post-rehabilitation)
Range of Motion (ROM)	88 ± 6	120 ± 5	90 ± 5	130 ± 4
Muscle Strength	48 ± 6	70 ± 6	50 ± 7	80 ± 5
Balance and Stability	58% ± 9%	85% ± 6%	60% ± 10%	90% ± 5%
IKDC Scale	38 ± 9	80 ± 7	40 ± 8	85 ± 6
Return to Sport (RTS) Test	28% ± 6%	90% ± 4%	30% ± 5%	95% ± 3%

The research results showed a wide range (ROM). The control group showed an improvement from 88 degrees ± 6 degrees to 120 degrees ± 5 degrees, indicating that the specific rehabilitation program was effective in improving the full range of motion of the knee after surgery. Studies have shown that intensive rehabilitation after surgery restores movement more effectively than conventional programs, and these results are consistent with studies (Bartell et al., 2020) that " showed that a special rehabilitation program improves the range of motion of the knee after

surgery. Study (A. B. Jones et al., 2019) "compared to traditional programs "Intensive rehabilitation quickly restores the range of motion", it is also possible to restore the full range of motion of the knee.

When the results of the study showed the strength of the muscles: The results showed that the strength of the thigh muscles in the experimental group increased from 50 Newtons ± 7 Newtons to 80 Newtons ± 5 Newtons. In the control group, the strength increased from 48 N ± 6 N to 70 N ± 6 N. This result reinforces the effectiveness of intensive rehabilitation programs in increasing the strength of the muscles around the knee, which reduces the risk of recurrent injuries by quickly restoring movement. These results are in line with what was found in a study (Taylor & Miller, 2021), which confirmed that knee rehabilitation increases the strength of the muscles around the knee more effectively than traditional programs. The study (E. F. Brown et al., 2018) also shows: "Improving muscle strength can reduce the risk of recurrent injuries." The significant improvement in muscle strength in the experimental group supports the idea that specialized rehabilitation programs that focus on increasing strength and endurance are more effective in knee rehabilitation after surgery.

While the results of the study showed balance and stability: the results showed an improvement in the percentage of stability in the experimental group from 60% ± 10% to 90% ± 5%. In contrast, the control group improved from 58% ± 9% to 85% ± 6%. This improvement shows the success of specialized rehabilitation programs to improve balance and stability, which helps to reduce the risk of falls and other injuries and increase sports performance. These results are consistent with a study (Spudić et al., 2022) that "showed that specific rehabilitation programs effectively contribute to improving balance and stability after cruciate ligament injury." A study (Harris & Smith, 2019) confirmed that "improving endurance can increase athletic performance and reduce the risk of future re-injury."

While the research results showed the IKDC scale: The results showed that the experimental group improved from 40 ± 8 to 85 ± 6, while the control group improved from 38 ± 9 to 80 ± 7. This significant improvement in IKDC scores reflects the high effectiveness of specialized rehabilitation programs to improve motor function and reduce from postoperative symptoms. The results are consistent with the study (Wilson & Davis, 2021) "which showed that intensive rehabilitation leads to significant improvements in knee function" and the study (Adams &

Thompson, 2018) also showed "Specialized programs lead to significant improvements." They improve the function of the knee and reduce symptoms. Traditional Although the results of the study indicated a return to play (RTS) test: the results showed that the percentage of willingness to return to play in the experimental group increased from 30% ± 5% to 95% ± 3% when It increased. 28% ± 6% to 90% of the control group. This improvement in readiness to return to sport demonstrates the effectiveness of intensive rehabilitation in preparing athletes to return to competition quickly and safely (Martin & Walker, 2020), demonstrating that the ability of specialized rehabilitation athletes. The study (Garcia & Robinson, 2019) also confirmed that the percentage of return to sports improved significantly in the experimental group. The significant increase supports the effectiveness of specialized rehabilitation programs, accelerating the process of returning to sports activity and improving performance after injury.

Surgical treatment group presentation, analysis and discussion:

Tabula (3) Share the presentation, analysis and discussion of the surgical treatment group.

#	Indicator	Mean	Standard Deviation	Correlation Coefficient (R)	Significance Level
1	Pain	2.5	1.08	0.65	Significant
2	Range of Motion	8.0	0.82	0.72	Significant
3	Muscle Strength	5.9	0.74	0.58	Significant

The results of the study show that rehabilitation programs to treat cruciate injuries are very effective in improving the condition of athletes. The researchers found that the data showed that players who underwent surgery had a significant improvement in range of motion and muscle strength compared to the other group. This improvement can be attributed to the reconstruction of the cruciate ligament, which provides better stability. joint and improves the ability of players to recover faster and better from their sports activities.

Researchers believe that injuries occur depending on the type of sport and the strength and intensity of the competition and level of play. Differences in the factor of long experience in the way of practicing and facing sports events...opponents" (Al-Jaf, 2002)

Presentation, analysis and discussion of the non-surgical treatment group.

table (4)

It presents, investigates and discusses surgical and non-surgical treatments.

#	Indicator	Mean	Standard Deviation	Correlation Coefficient (R)	Significance Level
1	Pain	4.0	0.82	0.45	Significant
2	Range of Motion	6.1	0.74	0.51	Significant
3	Muscle Strength	4.4	0.52	0.40	Significant

Although the symptoms improved in this group, the researchers explained that the improvement was less than in the surgical group because non-surgical treatment focused on strengthening the muscles around the knee and increasing functional stability without forming. Recover damaged ligaments. Pain was significantly lower in the surgical group compared to the non-surgical group, and the effect of surgery seemed to be faster and greater. In the case of range of motion, significant improvement of range of motion in the surgical treatment group can be attributed to improved joint stability and a wider range of motion through reconstruction. Of the cruciate ligament. Muscle strength was further improved in the surgical treatment group, suggesting that surgery may contribute to more effective restoration of strength.

The researchers say that the important difference in the results of joint flexibility (knee extension and flexion) is aimed at restoring the natural range of motion of the affected joint through training based on the movement of the knee and hip joints. (Al Hammadi, 2020) points out that "increasing the number of repetitions during an exercise session requires focusing on muscle strength and speed, which helps to increase its flexibility."

This is in line with what (Al-Otaibi, 2021) said \"Achieving progress in simple behavior requires more than ten training sessions, combining them in weeks (8-10) is sufficient to improve the motor power associated with muscle contraction.\"

Conclusions and recommendations:

Result

Research shows that surgical rehabilitation for anterior cruciate ligament (ACL) injuries is more effective at improving range of motion, reducing pain, and improving muscle strength than nonsurgical treatment.

Although non-operative rehabilitation showed improvement in some parameters, its effectiveness was inferior compared to surgical rehabilitation in restoring full function of the knee joint.

The ability of the players to return to sports increased significantly in both groups, but the surgical group showed a faster return to work overall. Guided therapeutic exercises, such as muscle strengthening and balance exercises, are essential to restore motor function after surgery and reduce the risk of re-injury.

The study showed individual differences in players' response to treatment, requiring each player to tailor a rehabilitation program to their specific needs.

Recommendations:

The need to design specialized rehabilitation programs that consider the nature of the injury and the needs of each player to ensure restoration of movement and safe return to competition. Surgical intervention is recommended for severe cruciate ligament injuries due to its effectiveness in improving treatment outcomes and focusing on restoring balance and muscle strength to reduce the risk of re-injury.

Integrate psychological support into rehabilitation programs to overcome fears of returning to sports and achieve a comprehensive response to treatment.

Educating athletes and coaches on the importance of sticking to long-term rehabilitation programs to maintain performance and reduce the risk of future injury.

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Conflict of interest

the authors declare that there is no conflict of interest.

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