



## Original Article

# Restoring Adductor Muscle Strength in Football Players: A Combined Approach of PRP Injections and Functional Rehabilitation

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## Abstract

The research aims to design a physical rehabilitation program supported by injections of platelet-rich plasma to determine its effect on improving muscle strength for the adductor muscle of the thigh and relieving pain for those with muscle tears thigh ligament. The researcher used the experimental method of one experimental group design. The main research sample was purposefully selected from football players suffering from partial tears of the adductor muscle. This sample included eight (8) players from the first division and youth sector teams of El-Dakhleya and El-Shorta Sports Clubs. Additionally, an exploratory sample consisting of four (4) players from the same population (but not included in the main sample) was selected. The results emphasized that there were significant differences between the pre- and post-measurement of the experimental group in the muscle strength of those with adductor muscle tears, and the improvement rate ranged between (33.106%:188.114%) in favor of the dimensional measurement of soccer players with partial rupture of the adductor muscles. There were significant differences between the pre- and post-measurement of the experimental group in the degree of pain sensation, as it improved (by 73.77%) in favor of the post-measurement for soccer players with adductor muscle tears.

**Keywords:** *Torn Adductor, Functional Exercises , Platelet-Rich Plasma*

## Introduction

Injury is considered one of the main obstacles that leads to a decline in both the physical and skill performance levels of athletes. It prevents the player from continuing regular training and may result, even after recovery, in incomplete performance and underdeveloped skills. This decline is mainly due to long periods away from the field and lack of training . (Farg, 2004)

Despite the significant advances in the field of sports rehabilitation in general, and injury prevention in particular, sports injuries continue to occur. These include minor injuries (Micro Trauma), which require only a few days and often do not prevent the athlete from continuing their sports activity, as well as major injuries (Macro Trauma), which may keep the athlete



away from the field for an extended period. Consequently, sports injuries have received considerable attention from researchers, not only to treat and rehabilitate the injured but also to understand and identify the types, locations, mechanisms, and causes of injuries, aiming to develop the most effective preventive measures . (Bakry, 2017)

Samia Khalil (2008) stated that the adductor muscles are among the most commonly injured muscles in athletes, with an injury rate ranging from 11.18% to 22.44%. This is mainly due to the lack of attention given to strengthening these muscles through proper warm-up, which includes full stretching of the adductors, or through strength training. The adductor muscles primarily function to bring the thigh inward and flex the thigh toward the abdomen (Khalil, 2008).

Elizaveta Kon, Roberto Buda, et al. (2009) noted that platelet-rich plasma (PRP) injections represent a natural autologous concentration of growth factors found in blood, and are being investigated across various medical fields for their potential to promote tissue regeneration and healing . (Kon, Buda, Filardo, & Di Martino, 2009).

PRP is produced by concentrating platelets derived from the patient's own plasma proteins. Platelets are widely recognized for their essential role in blood clotting and are used to treat many ligament injuries due to their ability to carry and transport healing-related enzymes and growth factors.

According to Mohamed Kadry Bakry (2017), functional physical rehabilitation is one of the fundamental natural approaches in the comprehensive treatment of sports injuries. Sports therapy is particularly important during the final phases of rehabilitation, when work-based therapy is implemented to prepare the injured individual to resume specialized activities and return to the field. Functional rehabilitation depends on various types of physical exercises and the therapeutic use of natural agents to complete the treatment and rehabilitation process. The aim is to restore the injured organ's basic natural functions, such as: restoring tactile sensation, regaining motor memory of the injured limb, recovering contraction and relaxation response speed, regaining muscular strength, and reestablishing neuromuscular coordination . (Bakry, 2017)

Injuries may range from minor cases like partial tearing of the muscle sheath or some fibers, to complete ruptures of the muscle or tendon. These changes are usually accompanied by varying degrees of bleeding and internal fluid accumulation, which define the size of swelling and pain level. In such cases, the injury is referred to as a partial tear . (Ateeto& Sabra ,2018)

The problem of the research emerged from the researcher's observations during his work as an injury and rehabilitation specialist at El-Dakhleya Football Club, and through reviewing literature and previous studies, as well as conducting interviews with football players and coaches. The researcher noticed a high rate of lower limb muscle injuries, particularly



partial tears in the adductor muscles, among football players. The delayed return of many key players to the field significantly impacts their teams, causing physical, emotional, and financial losses due to the absence of structured and scientific rehabilitation programs. In many cases, insufficient healing and incomplete or neglected therapeutic procedures lead to recurring injuries, especially during the pre-season preparation period rather than during competitions.

Through analyzing rehabilitation programs for adductor muscle tear injuries, the researcher observed that many players across different age categories suffer from such injuries without receiving final-stage functional exercises. Moreover, the recurrence of injuries among players after completing physiotherapy and rehabilitation sessions indicated a lack of proper preparation before returning to training and competition.

This led the researcher to attempt designing a rehabilitation program using functional training combined with platelet-rich plasma (PRP) injections, targeting the strength of partially torn adductor muscles in football players. The program was developed in coordination with an orthopedic specialist to apply the PRP injection protocol, and a medical laboratory was utilized to draw and separate blood components to obtain PRP. Human blood consists of approximately 6% platelets, 1% white blood cells, and 93% red blood cells. However, PRP injections alter these ratios at the injury site, increasing the platelet concentration to around 90%, which significantly enhances tissue regeneration and healing.

The proposed rehabilitation program was applied to the research sample, taking into consideration the nature of performance on the football field. It aims to accelerate the player's return and restore their efficiency in the shortest possible time, helping to avoid the complications, psychological, and financial issues that athletes may face due to such injuries. This research may benefit all football players suffering from partial muscle tear injuries in various body muscles.

This study aims to design a physical rehabilitation program supported by platelet-rich plasma (PRP) injections to investigate its effects on improving the muscular strength of the adductor muscle in the thigh, and reducing the level of pain perception in individuals suffering from partial tears of the adductor muscle in the thigh.

### **Study Hypotheses**

1. There are statistically significant differences between the pre- and post-test mean scores of the experimental group in both muscular strength and pain perception levels in favor of the post-test results, for individuals with partial tears of the adductor muscle in the thigh

### **Materials and Method**

The researcher adopted the experimental method, as it is appropriate for the nature of this study, utilizing a one-group experimental design. The study was conducted during the



2023–2024 sports season. The proposed rehabilitation program was implemented, and both pre- and post-measurements were conducted at the General Administration of El-Shorta Sports Club in Cairo.

### Participants

The research population consisted of first-division football players and youth sector players from El-Dakhleya Sports Club and El-Shorta Sports Club, who suffered from partial tears of the adductor muscles during the 2023/2024 sports season.

The main research sample was purposefully selected from football players suffering from partial tears of the adductor muscle. This sample included eight (8) players from the first division and youth sector teams of El-Dakhleya and El-Shorta Sports Clubs.

Additionally, an exploratory sample consisting of four (4) players from the same population (but not included in the main sample) was selected. Table (1) illustrates the characteristics of the research sample.

### *Criteria of Choosing the Participants*

1. Players must be officially registered with the Egyptian Football Association and actively participating in football activities.
2. Players must have a partial tear of the adductor muscles, with no other concurrent injuries.
3. Players must not be undergoing any other rehabilitation program.
4. Players must fully comply with the proposed rehabilitation program throughout the experimental period.
5. Players must not be participating in any sport other than football, whether individual or team based.
6. Full approval must be obtained from the players, coaches, and club management to implement the rehabilitation program in conjunction with PRP (platelet-rich plasma) injections.

Homogeneity was ensured among the members of the research population regarding the variables of age, height, and weight, confirming that all participants fall within the normal distribution curve. Table (1) presents the statistical description of the sample.

**Table 1. Statistical description of the basic measurements of the research sample of injured football players Partial tear of the adductor muscles (n = 16)**

Variable	Unit	Mean	Std. Deviation	Skewness	Kurtosis	Coefficient of Variation (%)
Age	year	21.88	1.310	0.260	-1.159	5.99
height	cm	176.50	3.347	-2.037	6.473	1.90



<b>the weight</b>	kg	70.88	2.553	-1.270	2.312	3.60
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As shown in Table (1), the minimum and maximum values, arithmetic means, and standard deviations of the basic measurements are presented. The values of skewness were close to zero, and the kurtosis values ranged between ( $\pm 3$ ), while the coefficients of variation were low, indicating low dispersion, normal distribution, and homogeneity among the research sample of football players with partial adductor muscle tears before conducting the main study.

### Data collection

The researcher reviewed specialized references, previous studies, and scientific research in the fields of physical rehabilitation, exercise science, and sports injuries. Expert opinions were also sought to assist in determining the structure of the proposed rehabilitation exercise program, the use of PRP (Platelet-Rich Plasma) injections, and the measurements and tests used in the study.

A data registration form was used to record the variables under investigation for the research sample. An expert opinion form to gather feedback on the proposed rehabilitation program and the tests employed, particularly the PRP-supported functional rehabilitation exercises.

### Pilot studies

The researcher conducted a preliminary study from Sunday, November 12, 2023, to Tuesday, November 14, 2023, on 4 football players from the first division and youth sector of El-Dakhleya SC and El-Shorta SC, who suffered partial adductor muscle tears. This study aimed to:

- Ensure the accuracy and functionality of the tools and devices used in the study.
- Learn the proper method for conducting practical measurements.
- Train the assistants on how to properly conduct measurements and apply the program

### Proposed Training Program

The proposed rehabilitation program is the main tool for achieving the study's objectives. It includes rehabilitation exercises that aid in developing the strength of the adductor muscles, elongating the muscles working on the thigh, and enhancing the flexibility of the hip joints. The researcher designed the exercises as part of a movement program that was applied to the research sample according to the following procedural steps:

#### *Objectives of the Program*

The rehabilitation program aims to restore healing from partial adductor muscle tears in football players through the following components:

1. Strengthening the adductor muscles.
2. Achieving balance between muscle groups.
3. Improving the functional state of the hip joint.



4. Restoring the natural function of the injured adductor muscles and the entire thigh muscles.
5. Reducing the pain of the injured adductor muscles.

### *Principles of the Program*

When designing the proposed rehabilitation program for the research sample, the following principles were considered:

- Ensuring the exercises align with the overall program goal.
- Ensuring the exercises are suitable for the injury severity and the physical health of the players.
- Gradual progression from simple to complex exercises, from assisted to free exercises, and then progressing to resistance-based exercises.
- Including rest periods between exercises and sets to avoid fatigue.
- Including negative stretching exercises with the help of the therapist whenever possible.
- Ensuring integration of all components within the program.
- Starting the program with isometric exercises.
- Avoiding exercises in the presence of pain, training only until pain onset.

### *The Program's outlines*

The rehabilitation program was implemented using muscular strength exercises for the adductors, flexibility exercises for the hip joint, and muscle elongation exercises. The details are as follows:

- The program was conducted over a total period of 6 weeks with 5 rehabilitation sessions per week, totaling 30 rehabilitation units.
- Each session duration ranged from 15 to 30 minutes, depending on the rehabilitation phase and each player's condition.
- Rest periods between exercises varied from 10 to 20 seconds.
- The session was divided according to physiological properties (warm-up, main part, cool-down).

### **Warm-up:**

The goal was to prepare the body physically and physiologically to accept the exercises in the next phase and avoid injuries during movement. The warm-up exercises included:

- Light exercises (walking, jogging, hopping).
- The warm-up duration ranged from **5 to 10 minutes**, with gradual increases in time throughout the program.

### **Main Part:**

The main part of the program included:

- Strengthening the adductor muscles.
- Enhancing the range of motion of the hip joint.



- Increasing the elongation of the injured adductor muscles.
- Using ultrasound waves followed by deep massage on the injury site, then performing the exercises.
- The experimental group consumed amino acids during the trial, with a gradual increase in dosage as per the proposed methodology.

### **Cool-down**

The goal of this phase was to return the heart rate to its resting state gradually through cool-down exercises such as light walking, jogging, or swinging, alongside breathing regulation to reduce fatigue. This phase lasted 5 minutes after each session.

### ***Use of Platelet-Rich Plasma (PRP) Injections***

PRP Treatment Steps:

1. Blood Draw: A blood sample (up to 10 cc) is drawn from the patient's vein using a sterile technique.
2. Blood Centrifugation: The blood is processed using a centrifuge to separate platelets and tissue growth factors, producing plasma with a sufficient concentration of platelets for treatment.
3. Injection: The concentrated platelets are injected into the injured areas to reduce pain and promote better healing, administered by a qualified doctor.

PRP Injection Duration and Frequency:

- PRP injections are typically administered 2 to 3 times for treatment.
- The interval between injections is usually 3 to 4 weeks, or as recommended by the physician.

### ***Pre measurements***

The researcher conducted pre-test measurements, including physical variables (muscular strength with 4 tests) and pain intensity for each participant. These tests were conducted from Saturday, November 25, 2023, to Monday, November 27, 2023, before beginning the rehabilitation program.

### ***Physical Tests***

1. The researcher reviewed scientific references and previous studies to identify the most appropriate physical tests relevant to the research sample and the degree of injury.
2. Based on the literature analysis, a list of potential physical measurements and tests was compiled. The researcher then developed a form to solicit expert opinions to finalize the most suitable tests for the sample.
3. The expert feedback helped finalize the selection of the key physical tests and measurements for the study

From Table (2), the percentage of expert opinions regarding the physical measurements ranged from 100% to 77.78%. The researcher adopted a 75% approval rate to determine the





most important physical measurements for the study. Through the expert opinions survey, the researcher selected the following physical tests:

1. Dynamometer (for measuring muscular strength of the injured muscles).
2. Pain Intensity Scale: The researcher used the Visual Analog Scale (VAS) to measure pain intensity.

**Table (2) Percentage of expert opinions around the Physical tests**

Variables	Tests	I agree		I do not agree	
		Nr.	rate	Nr.	rate
Muscle strength	(Standing) Move the man outward	8	88.89%	1	11.11%
	(Standing with the feet facing inwards) Bringing the feet closer to the inside	7	77.78%	2	22.22%
	Thigh muscle measurement (anterior)	9	100%	0	0.00%
	Thigh muscle measurement (posterior)	8	88.89%	1	11.11%

### *The main study*

The proposed rehabilitation program was implemented over 6 weeks with 5 weekly sessions (a total of 30 sessions, divided into three phases, each lasted 2 weeks:

1. Phase 1: From Friday, December 1, 2023, to Friday, December 15, 2023.
2. Phase 2: From Saturday, December 16, 2023, to Saturday, December 30, 2023.
3. Phase 3: From Sunday, December 31, 2023, to Sunday, January 14, 2024. The control group followed the traditional rehabilitation program without PRP injections.

### *Post Tests*

After completing the 6-week intervention program, post-test measurements were conducted from Monday, January 15, 2024, to Wednesday, January 17, 2024, under the same conditions as the pre-test measurements.

### *Tools and Devices (measurements & program)*

The researcher prepared all necessary tools and equipment to conduct the required measurements and implement the proposed rehabilitation program, including:

1. Height measurement device (to the nearest cm)
2. Calibrated scale for weight measurement (to the nearest kg)
3. Dynamometer for measuring muscular strength
4. Goniometer for range of motion assessment
5. Football cones, discs, and hurdles
6. Stopwatch
7. 3-kg medicine ball
8. Swiss ball
9. Massage oils and creams
10. Adductor muscle training machine
11. Treadmill





12. Balance board/device
13. Hamstring training device
14. Stationary bike
15. Natural grass football pitch

### Statistical Analysis

The collected data and results from the various tests and measurements were processed using statistical methods, utilizing both Excel and SPSS software. The statistical analyses included:

- Mean.
- Standard Deviation.
- Percentage.
- Skewness.
- Kurtosis.
- Independent Samples t-test

### Results and Discussion

It is evident from Table (3) that there are significant differences in the calculated "t" value between the pre-test and post-test for the experimental group in muscle strength for participants with adductor muscle strain. The improvement percentage ranged from 33.106% to 188.114%, favoring the post-test for football players with partial adductor muscle strain.

**Table 3. Significance of differences between the pre- and post-measurement of the experimental group in muscle strength and range of motion for patients with adductor muscle tears (n = 8)**

Tests		Units	Pre-test		Post-test		Mean difference	"t" value*	Change Percentage %
			M	±SD	M	±SD			
Muscle strength	(Standing) Leg Abduction	kg	30,78	1.99	40.97	2,00	-10.190	-9.556	33.106
	(Lying on Back) Leg Abduction	kg	22,48	1.69	31,15	1.57	-8.670	-9.944	38,568
	Quadriceps Muscles	kg	30.25	1.07	61,93	5.82	-31.680	-14.16	104,727
	Hamstring Muscles	kg	15,06	1.15	43,39	6,05	-28.330	-12.17	188.114

\*The table value of "t" at 0.05 = 2.365, \*at the 0.01 = 3.499.



It is evident from Table (4) that there are significant differences in the calculated "t" value between the pre-test and post-test for the experimental group in pain perception, with an improvement of 73.77% in favor of the post-test for football players with adductor muscle strain.

**Table 4. Significance of differences between the pre- and post-measurement of the experimental group in the degree of pain sensation for patients with adductor muscle tears (n = 8)**

Variable	Unit	Pre-test		Post-test		Mean difference	"t" value	Change Percentage %
		Q-	±A	Q-	±A			
degree of pain sensation	degree	7.63	0.92	2,000	0.76	1.06	15.00*	73.77%

\*The table value of "t" at 0.05 = 2.365, \*at the 0.01 = 3.499

The researcher attributes these results to the diverse rehabilitation exercises and the use of Platelet-Rich Plasma (PRP) injections, which played a clear role in this improvement. The program included exercises for strength, flexibility, and endurance, using various types of training specific to these muscles. The proposed program, combining rehabilitation exercises with PRP injections, significantly improved physical measurements, which in turn helped accelerate recovery from adductor muscle strain in football players.

The researcher also observed that after applying the motor rehabilitation program, along with scientifically calibrated PRP injections, the research participants achieved gradual improvement in their physical condition. This can be attributed to the balanced nature of the rehabilitation exercises and the PRP treatments included in the program. These findings are consistent with the work of Mustafa, I, K (2007), who highlighted that a balanced rehabilitation program significantly impacts physical, functional, and motor performance. (Kamel, 2007)

The researcher further emphasizes that the proposed program varied in its training regimen, which included exercises for muscular strength and range of motion of the hip joint, targeting the adductor muscles. The combination of rehabilitation exercises and PRP injections is an approach that focuses on the relationship between muscles and the nervous system, and the impact of this relationship on overall health. The purpose of this combined treatment is to strengthen the adductor muscles, restore the natural function of the nervous system, and manage pain, thereby allowing the body to heal itself.

This aligns with the view of Abdelazim Elawadly (2004), who suggested that the primary goal of rehabilitating the adductor muscles after a partial strain is to restore the muscle's stability. This is achieved by training the muscles around the injured area, particularly those that stabilize the hip joint and femur. Adductor muscle injuries are among the most severe



injuries in athletes, as they can compromise the future performance of players. The importance of these muscles in maintaining anterior joint stability, preventing tibial translation on the femur, and limiting excessive knee extension is critical to the player's overall mobility and performance. (Elawadly, 2004)

The researcher attributes these differences to the tailored design of the rehabilitation programs and the use of PRP injections, which were specifically created to meet the needs of each participant based on their injury type and severity. This approach helped increase biochemical variables and reduce pain levels. According to Grandjean (2008), the goal of rehabilitation exercises is to eliminate pain and restore normal muscle movement, with exercises tailored to the severity of the injury. Rehabilitation exercises help reduce muscle strain, and as the patient improves, muscle training progresses with increased range of motion. Initially, isometric (negative) exercises are used to reduce pain while preserving the core muscle strength. In the later stages, resistance exercises with maximum movement range are applied, with the exercises continuing to increase mobility and reduce pain. If pain increases with any exercise, the intensity of the exercise should be reduced (Grandjean, 2008).

## Conclusion

Considering the study's objectives, questions, the scope of the study and based on the results and data collected, as well as the statistical treatments used, the researcher reached the following conclusions:

1. There were significant differences between the pre-test and post-test for the experimental group in muscular strength for participants with adductor muscle strain, with improvement ranging from 33.106% to 188.114%, favoring the post-test.
2. There were significant differences in pain perception, with a 73.77% improvement in favor of the post-test for participants with adductor muscle strain.

## Recommendations

Based on the study's results and the conclusions drawn, the researcher recommends the following:

1. Implement the proposed rehabilitation program for football players with partial adductor muscle strain to facilitate recovery, with a focus on combining rehabilitation exercises and PRP injections to speed up recovery and prevent reinjury.
2. Apply the principles of the proposed rehabilitation program to other similar injuries to optimize rehabilitation efforts for other muscle strains.
3. Conduct further research to develop better diagnostic methods for injuries and assess the degree of recovery and pain levels at different stages of rehabilitation.

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