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Platelet-Rich Plasma as an Adjunct to Rehabilitation for Partial Rotator Cuff Tears in Recreational Athletes: A Comparative Study

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Learning Point of the Article:

In young recreational athletes with partial rotator cuff tears, PRP combined with structured rehabilitation improves functional outcomes and return-to-sport rates compared with rehabilitation alone.

Abstract

Introduction: The role of platelet-rich plasma (PRP) in the treatment of partial rotator cuff tears (RCTs) in young recreational athletes remains controversial. Our study aimed to investigate the efficacy and return-to-sports (RTS) rates of two commonly prescribed treatment options for partial RCTs in young recreational athletes.

Materials and Methods: Sixty-one young recreational athletes with partial RCT were assigned based on patient preference to two groups: Physical therapy (PT) group (28 patients) receiving a standardized rehabilitation program and PRP with PT group (33 patients) receiving ultrasound-guided PRP injection at the site of the tear along with the same rehabilitation program. Functional outcomes such as the American Shoulder and Elbow Surgeons (ASES) score, Disabilities of the Arm, Shoulder, Hand (DASH) score, Constant–Murley score, and Visual Analog Scale (VAS) score were assessed at baseline and after 6 months.

Results: At 6 months, the PRP with PT group demonstrated significantly greater improvements in functional outcomes compared to the PT group. Adjusted Constant-Murley (89.4 vs. 79.5; $P < 0.001$) and ASES scores (83.7 vs. 75.2; $P < 0.001$) were higher in the PRP with PT group, while QuickDASH scores (48.8 vs. 24.5; $P < 0.001$) showed a steeper adjusted decline, indicating superior recovery of shoulder function in the PRP with PT group. However, after adjusting for baseline, VAS scores did not differ significantly between groups. RTS rates were 50% in the PRP with PT group versus 20% in the PT group ($P < 0.05$).

Conclusion: Autologous PRP injection among recreational athletes with partial RCTs is an effective tool to be used as an adjunct to rehabilitation owing to its effect on improving shoulder function, reducing disability, and allowing greater rates of RTS.

Keywords: Platelet-rich plasma, rotator cuff tear, autologous, return to sports, recreational athlete.

Introduction

Rotator cuff tears (RCTs), which are responsible for up to 40% of shoulder joint disorders, are frequently linked to discomfort and a reduction in physical activity [1,2]. Patients diagnosed with rotator cuff tendinopathy suffer from a significant deterioration in their quality of life owing to functional limitation, decreased range of motion, and an inability to perform several actions that require overhead motions [3]. Among athletes, prevalence rates of RCTs have been reported to be as high as 40% in the dominant shoulder [4]. In a study

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highlighting the burden of the disease in athletes, rotator cuff-related injuries accounted for 39% of gradual onset shoulder pain, of which 59% resulted in time loss from sport [5]. Furthermore, it has been reported that the incidence of RCTs is higher in throwing athletes, with tears involving the articular portion of the tendon [6]. Based on their extent, these tears are classified into two categories: Full-thickness tears and partial-thickness tears [7,8,9]. Partial-thickness RCTs (PTRCTs) are a frequent type of shoulder injury, affecting around 4% of people under 40 years old, 26% of those over 60, and 20% of the general asymptomatic population [10]. The treatment of choice for younger individuals with acute symptomatic partial or full-thickness injuries that cause significant functional impairment is often surgical intervention. Conversely, conservative management is generally advised for the treatment of cases that involve partial injuries or tendon degeneration that affects <50% of the tendon thickness [8,9,11,12]. These techniques encompass corticosteroid injections, non-steroidal anti-inflammatory drugs, pain relief medications, activity modification, and physical therapy (PT) [12,13,14]. Surgical intervention is typically warranted in patients who do not respond to conservative treatment after 3–6 months and in younger individuals with complete traumatic tears. Numerous systematic reviews in recent years have established the efficacy of PT in the treatment of rotator cuff diseases [15,16,17,18]. Alongside PT intended to alleviate symptoms, numerous invasive techniques have also been studied as an adjunct [19]. Over the previous two decades, there has been a growing interest in biological treatments that augment the repair and function of wounded tendons and muscles, as well as provide better pain relief. The utilization of platelet-rich plasma (PRP), an autologous blood product that is obtained by centrifuging a patient's own blood to obtain a concentrated number of platelets, is one such approach [20]. PRP is identified by its platelet concentration, which surpasses the body's typical physiological levels. Inflammation, angiogenesis, cell proliferation, and stem cell migration are among the numerous biological processes in which platelets are critically involved [21]. As platelets release growth factors that promote tissue repair and regeneration, these mechanisms are essential for the initiation of tissue healing [22,23]. Tendons typically have an inadequate blood supply, which prevents the torn or degenerated tissues from receiving the necessary nutrients to facilitate repair. Consequently, their regeneration capacity is restricted. The injured site is supplied with restorative growth factors through PRP injection, which are challenging to access due to inadequate blood supply [24]. Over the past decade, there has been a growing body of evidence examining the efficacy of PRP in improving structural healing and clinical outcomes in RCTs. However, to our knowledge, no study has specifically evaluated its impact on return-to-sport (RTS) rates in recreational athletes, which remains a critical gap in the literature. The present study aimed to compare the outcomes of two treatment approaches – PT alone versus PRP combined with PT – in patients with traumatic partial RCTs over a 6-month follow-up. In addition, we sought to document and compare RTS rates between the two treatment groups.

Materials and Methods

Study design and participants

Our study was conducted to explore an approach to treating traumatic partial RCTs in young patients. Participants were eligible for inclusion if they were 18–50 years of age and had unilateral shoulder pain for at least 3 months. On examination, participants demonstrated either a Neer's or Hawkins impingement sign and/or a painful arc and/or a positive Jobe test. Radiographic diagnosis of partial RCT was confirmed with magnetic resonance imaging (MRI). Participants were additionally required to be recreational athletes, defined as adults engaged in organized or informal sport for at least 12 months before injury, training a minimum of two sessions per week (≥3 h/week), competing only at a community or club level without salaried/professional status, and with the stated intention to return to the same sport and level following treatment. Exclusion criteria included previous subacromial injections within the past 6 months, a full-thickness RCT as demonstrated with MRI, and limitation of active and passive movements of the glenohumeral joint by 25% in at least two directions compared with the contralateral shoulder. This prospective cohort study compared the outcomes of two treatment groups: One group received only PT, while the other received combined PT with PRP injections (PRP+PT). The patients were given detailed information regarding the two management options and were assigned to either group as per their preference. To enhance reliability, the study design ensured that the outcome assessor was blinded to the treatment groups. The PT Group (28 patients) followed a standardized rehabilitation program for 6 months, which progressed from improving range of motion to regaining the scapular rhythm along with rotator cuff strengthening to eventually advanced exercises along with proprioception exercises for the injured shoulder. The PRP+PT Group (33 patients) underwent the same rehabilitation program but also received ultrasound (USG)-guided PRP injections (Table 1).

Autologous PRP preparation

The PRP was obtained from an automated plateletpheresis system using the patient's own blood through a meticulous

process; the patient's blood was collected under aseptic conditions in acid citrate dextrose tubes. An antecubital blood draw of 20 mL was done and put in a centrifuge at 2000 rotation/min (soft spin). The whole blood was separated into three layers. The supernatant layer of plasma and buffy coat was separated and subjected to centrifugation at 3000 rotations per minute. In the end product, the upper two-thirds of the tube containing platelet-poor plasma was removed, and the lower one-third, PRP enhanced with a superficial buffy coat, was used for injection.

Table 1: Standardized rehabilitation program followed by the two groups

Phase	Category	Protocol
PHASE I: Weeks 0–4 (ROM)	Pain Control	• Therapeutic modalities
		• Ice, ultrasound, TENS
		• Moist heat before therapy, ice at the end of the session
		• Manual therapy – pec minor, post capsule, levator scapulae, upper trapezius, rhomboids, latissimus dorsi
	Exercises	• Begin with Codman pendulum exercises
		• Passive ROM: Forward flexion, Extension, Internal and external rotation
		• Grip exercises
		• Pronation and supination of the forearm
		• Improve thoracic and lumbar posture
		• Progress to AAROM → AROM
		• AAROM wand: Flexion, Abduction, Adduction, IR/ER, Pulley-assisted elevation
		• AROM and Wall slides
PHASE II: Weeks 4–8 (flexibility and strengthening)	Pain Control	• Continue modalities
		• Ice, ultrasound, TENS
		• Moist heat before therapy, ice at the end of the session
	Exercises	• Continue AROM
		• Capsular stretching: Anterior, posterior, inferior (door stretch, cross body, trapezius stretch) – 5×30 sec daily
	Muscle Strengthening (×3/week, 3×15 reps)	• Closed-chain isometrics: IR, ER, Abduction, Flexion
		• Progress to open-chain with light dumbbells/bands: Shoulder flexion (supine, inverted, standing), Standing ER with band, Side-lying ER
		• Scapular setting: Retraction rows, Low row isometrics
		• Supine presses: Press, Press + Protraction, Press + Triceps extension, Multi-angle isometric holds
		• Scapular depression (LD, trap, SA)
		• Shoulder shrugs
		• Push-up plus on wall
		• Quadruped scapular protraction
		• Wall stabilization
		• Open-chain stabilizers: T, I, Y, W, Rows, standing scapula press with band
PHASE III: Weeks 8–12 (advanced strengthening and proprioception)	Kinetic Chain	• Upright Fitball push-ups
		• Dynamic Hug exercise
		• Standing cable row
		• ER at 90° with band/dumbbell
		• ER in 90° prone horizontal abduction
		• IR at 90° standing with band
		• Prone reactive ball exercises
	Neuromuscular Re-education	• Advanced closed-chain exercises

ROM: Range of motion, IR: Internal rotation, ER: External rotation

Ultrasonography-guided injection technique

Each participant underwent a single injection of PRP. The procedure began with a diagnostic USG to detect the site of the subacromion bursa, following which the patient was positioned in a sitting position, and the site of injection was decided. Under complete aseptic conditions, sterile surgical gloves, probe cover, and sterile gel were used, and 10% povidone-iodine solution was used to sterilize the site of injection and probe surface. Three milliliters of local anesthetic were administered subcutaneously at the injection site. Then, using a 22-gauge spinal needle, 5–7 mL of the PRP product was injected under USG guidance into the partially torn rotator cufff tendon.

Outcome measures

The effectiveness of the interventions was assessed using four validated questionnaire tools: The American Shoulder and Elbow Surgeons (ASES) score, Disabilities of the Arm, Shoulder, and Hand (DASH) score, Constant–Murley score (CMS), and the Visual Analog Scale (VAS) for pain. Baseline measurements and scores were taken before treatment, and follow-up scores were obtained 6 months later for both groups.

Ethical considerations and informed consent

This study was conducted following the ethical guidelines outlined in the Declaration of Helsinki and was approved by the Institutional Ethics Committee. Ethical principles were adhered to at all stages of the research to ensure the safety, dignity, and rights of all participants.

Informed consent process

Before enrollment in the study, all participants were thoroughly informed about the purpose, procedures, risks, and potential benefits of the research. This information was communicated in a language that each participant could understand. Participants were also assured that their decision to participate was voluntary and that they could withdraw from the study at any time without any impact on their standard medical care.

Statistical analysis

The Statistical Package for the Social Sciences (SPSS) version 29 (IBM SPSS Statistics [IBM Corp.,

Table 2: Study demographics

Variable	Group 0 (control) (%)	Group 1 (PRP) (%)	*P*-value
Gender			
Female (f)	8 (28.6)	8 (24.2)	0.702
Male (m)	20 (71.4)	25 (75.8)	
Age			
Mean (SD)	38.71 (7.13)	36.87 (7.49)	0.334

PRP: Platelet-rich plasma, F: Female, M: Male, SD: Standard deviation

2011]) was used to perform the statistical analysis. Data normality distribution was then determined using the Shapiro–Wilk test. To assess for statistical differences between groups, independent-samples t-tests were applied for parametric data, and the Mann–Whitney test was applied for non-parametric data. The level of significance was set at 0.05.

Results

The demographic analysis showed no significant differences in gender or age between the groups, ensuring unbiased outcomes. Gender distribution was similar, with 28.6% females and 71.4% males in the Control group, compared to 24.2% females and 75.8% males in the PRP group (P = 0.702). The average age was slightly higher in the Control group (38.71 ± 7.13 years) than in the PRP group (36.87 ± 7.49 years), but this difference was not significant (P = 0.334) (Table 2).

<H3>Before intervention

• The Shapiro–Wilk test at baseline for the two groups revealed that the QuickDASH score for PRP+PT, the ASES score for the PT and PRP+PT groups, and the Constant score for PT and PRP+PT showed normal distribution. The QuickDASH score for PRP+PT, VAS score for PT, and PRP+PT groups showed non-parametric distribution (Table 3).

• Pre-intervention between-group analysis revealed that the mean ASES and Constant scores in the PT group were significantly greater than in the PRP+PT group, indicating the PT group had better shoulder function and improved ability to perform daily activities (Table 3).

• The Mann–Whitney test revealed that the median QuickDASH and VAS scores before intervention were significantly higher in the PRP+PT group than in the PT group, indicating greater functional disability and higher pain levels at baseline among patients in the PRP+PT group (Table 4).

At 6-month follow-up

• Analysis of covariance (ANCOVA) was conducted to compare post-intervention Constant and ASES scores between the PT group and PRP+PT groups while controlling for their respective baseline scores. After adjusting for baseline scores, the PRP+PT group showed significantly higher post-intervention Constant–Murley scores (89.4 ± 1.39) compared to the PT group (79.5 ± 1.22), P < 0.001, partial η2 = 0.59. Similarly, the PRP+PT group demonstrated higher ASES scores (83.7 ± 1.26) compared to the PT group (75.2 ± 1.20), P < 0.001, partial η2 = 0.55 (Table 5).

• For outcomes that violated parametric assumptions (QuickDASH and VAS), ranked ANCOVA was used to control for baseline scores. Ranked ANCOVA showed that the PRP+PT group had significantly lower adjusted ranked QuickDASH scores (24.5 ± 1.04) compared to the PT group (48.8 ± 1.91), P < 0.001, partial η2 = 0.86, indicating better functional outcomes (Table 4).

• The VAS scores showed no significant between-group difference after adjustment.

Return to sport rates

• At the 6-month follow-up, RTS rates differed between the two treatment groups. In the PT group, 20% of participants successfully returned to their pre-injury sport level, without any residual pain. On the other hand, the PRP+PT group had notably higher RTS rate of 50%, without any residual pain.

Discussion

PTRCTs are complex problems in athletes and are multifactorial, more so in a throwing athlete, where the act of

Table 3: Shapiro–Wilk analysis for outcome variables

Groups	Variables	Shapiro-Wilk			
		n	Statistic	df	*P*-value
PT	QuickDASH score	28	0.971	28	0.596
	ASES score	28	0.967	28	0.509
	Constant score	28	0.986	28	0.963
	VAS score	28	0.915	28	0.026
PRP+PT	QuickDASH score	33	0.811	33	<0.001
	ASES score	33	0.945	33	0.102
	Constant score	33	0.939	33	0.068
	VAS score	33	0.875	33	0.002

Significance set at *P*<0.05. PT: Physical therapy, PRP: Platelet-rich plasma, VAS: Visual Analog Scale, DASH: Disabilities of the arm, shoulder, hand

Table 4: Between-group analysis before procedure

Outcomes scores	PT		PRP+PT			
Independent *t* -test						
	Mean	**SD**	**Mean**	**SD**	**t-value**	***P*-value**
Constant Murley	78.36	4.98	55.09	9.51	11.61	<0.001*
ASES	57.5	7.36	45	9.32	5.706	<0.001*
Mann–Whitney test +						
	Median	**IQR**	**Median**	**IQR**	**Z statistic**	***P*-value**
QuickDASH	21.6	11.4	53.1	19	−5.245	<0.001*
VAS	60	10	70	10	−2.405	0.016*

Significance set at *P*<0.05. PT: Physical therapy, PRP: Platelet-rich plasma, SD: Standard deviation, SE: Standard error, VAS: Visual Analog Scale, DASH: Disabilities of the arm, shoulder, hand, IQR: Interquartile range, ASES: American Shoulder and Elbow Surgeons

overhead throwing may place a significant amount of stress on the glenohumeral joint, requiring the rotator cuff muscles to overcome these forces to stabilize the glenohumeral joint [25]. The management of PTRCTs in athletes remains controversial, particularly during the competitive season, when surgical repair can result in substantial time lost from sport [26]. PRP has emerged as a promising treatment option for musculoskeletal disorders in recent years; however, there is still no consensus on its optimal application in the management of rotator cuff pathology. Most studies on the treatment of PTRCTs have explained surgical techniques or outcomes; few studies have evaluated the clinical outcomes and RTS rates of two commonly employed management strategies for PTRCTs: Rehabilitation alone and rehabilitation combined with orthobiologicals. In the present study, we intended to evaluate the efficacy of adding PRP to a standardized rehabilitation program when compared to exclusive rehabilitation for treatment of PTRCT. We observed notable differences in outcomes between the PT group and the PRP+PT group. We found that PRP injections combined with PT outperformed exclusive PT in improving shoulder function, reducing disability, and alleviating pain in patients with traumatic partial RCTs. Furthermore, the PRP+PT group demonstrated higher rates of return to sport compared with the PT group, thereby strengthening the evidence for PRP as a valuable adjunct in the treatment of athletes with RCTs.

The study revealed that the PRP+PT group demonstrated significantly better outcomes compared to the PT group across multiple measures. It was noted that 6 months after the intervention, the QuickDASH scores were significantly lower in the PRP+PT group when compared to the PT group after adjustment for baseline values, reflecting superior gains in shoulder function, reduction in pain during daily activities, and improved ability to perform overhead and sport-related tasks. Similarly, after adjusting for baseline values, ASES scores showed a more pronounced improvement in the PRP+PT group, indicating greater recovery of shoulder function even though this group started with lower baseline scores when compared to the PT group. In terms of CMSs, after adjusting for baseline values, the PRP+PT group demonstrated greater improvements in pain relief, strength, and range of motion, underscoring superior functional recovery compared to the PT group. However, VAS scores did not show a statistically significant difference between the two groups after adjustment for baseline values, possibly because pain intensity is a more subjective measure with limited sensitivity to change, and functional improvements achieved through PRP and rehabilitation may not always parallel reductions in perceived pain. These findings collectively underscore the enhanced effectiveness of PRP injections combined with physiotherapy in improving shoulder function and alleviating pain.

The group receiving the PRP injections with PT exhibited significantly worse baseline scores (QuickDASH, ASES, and

Table 5: Comparison of outcomes between groups at 6-month follow-up using ANCOVA and ranked ANCOVA (adjusted for baseline values)

Outcome variables	PT group (adjusted mean±SE)	PRP+PT group (adjusted mean±SD)	Test statistic	*P*-value	Effect size
A. ANCOVA test					
Constant Murley	79.5±1.22	89.4±1.39	42.37	<0.001*	0.59
ASES score	75.2±1.20	83.7±1.26	36.78	<0.001*	0.55
B. Ranked ANCOVA test					
	PT group (adjusted ranked mean±SE)	**PRP+PT group (adjusted ranked mean±SE)**	**Test statistic**	***P*-value**	**Effect size**
Quick DASH	48.8±1.91	24.5±1.04	184.5	<0.001*	0.86
VAS score	22.7±2.55	50.56±4.57	11.67	0.568	0.28

Significance set at *P*<0.05. SD: Standard deviation, SE: Standard error, VAS: Visual Analog Scale, DASH: Disabilities of the arm, shoulder, hand, PT: Physical therapy, ANCOVA: Analysis of covariance, PRP: Platelet-rich plasma, ASES: American Shoulder and Elbow Surgeons

Constant-Murley) when compared to the group receiving PT. This aligns with the findings by Ilhanli et al., who emphasized the use of PRP for patients with chronic partial supraspinatus tears, a population often presenting with more severe baseline symptoms. This suggests that PRP may be particularly useful for patients with more significant functional deficits [27].

The PRP+PT group showed significantly greater improvements in functionality measures such as QuickDASH, ASES, and CMSs, indicating that PRP injections enhance the effectiveness of PT. These findings align with the conclusions of Rha et al., who found PRP to be safe and effective in improving shoulder function [28]. Similarly, Cai et al. demonstrated that PRP in combination with sodium hyaluronate produced superior clinical outcomes compared to either treatment alone, supporting the idea of combined approaches leading to enhanced recovery [29].

The greater improvement in CMSs (pain, strength, and range of motion) in the PRP+PT group also reflects findings from Sari and Eroglu (2020), who observed that PRP outperformed corticosteroid injections in enhancing rotator cuff lesion recovery [30].

Both groups demonstrated a reduction in VAS scores over the follow-up period, but improvement was not statistically significant ($P = 0.568$). This result contrasts with findings from Ibrahim et al., who reported superior pain relief with PRP compared to corticosteroids and may suggest variability in outcomes based on patient populations or methodological differences [31]. Furthermore, Mautner et al. found that 75% of patients showed VAS pain score improvement, with 95% reporting no pain at rest and 68% no pain during activities [32], consistent with the findings of Ibrahim et al. Similarly, Wesner et al. also confirmed significant improvements in pain and disability in PRP-treated patients [33]. The lack of a significant difference in VAS scores between the groups may be attributed to the fact that all participants underwent structured physiotherapy, which is known to provide substantial pain relief in rotator cuff–related injuries. This finding underscores that rehabilitation remains the cornerstone of first-line management in partial RCTs, with biologic adjuncts such as PRP potentially offering additional benefits in functional recovery and return to sport rather than in pain relief alone.

Adding PRP to standard rehabilitation may represent a valuable option for athletes with partial RCTs, particularly during the competitive season when surgical management could result in substantial time loss from sport [26]. From an ethical and anti-doping standpoint, the use of PRP is permitted in sports; however, the administration of isolated growth factors in concentrated form is prohibited [34]. Physicians should remain mindful of this distinction. In this context, PRP provides sports medicine practitioners with a safe and legitimate adjunctive tool for managing PTRCTs in athletes. Importantly, our study demonstrated higher RTS rates in the PRP+PT group compared to the PT-only group, reinforcing the potential role of PRP as an adjunctive therapy. Collectively, these findings highlight the clinical relevance of incorporating PRP into rehabilitation strategies, particularly for athletes seeking timely return to play.

We acknowledge the limitations in our study. A key concern is that group allocation was based on patient preference rather than randomization, which introduces the possibility of selection bias into the research. However, our primary intention was to compare the outcomes of two available treatment options in a real-world clinical setting. Randomizing participants would have required withholding their choice of treatment, which could pose an ethical dilemma, particularly in athletes making decisions about their careers and RTS timelines. Second, long-term follow-up was not conducted, limiting our ability to assess the durability of functional improvements and RTS outcomes beyond 6 months. Future studies should incorporate objective imaging modalities and extended follow-up periods to better understand the efficacy of PRP treatment, particularly among athletes, and to evaluate its impact on tendon healing and sustained RTS performance.

Conclusion

Autologous PRP injections for the treatment of rotator cuff disease are safe, and combining PRP injections with PT is more effective in improving strength, shoulder function, reducing disability, and allowing greater return-to-sport rates when compared to exclusive PT, in young patients with partial RCTs. These results support the use of PRP as a valuable adjunct to PT in the treatment of partial RCTs.

Clinical Message

In young recreational athletes with partial RCTs, PRP used as an adjunct to a structured rehabilitation program may improve shoulder function and increase RTS rates compared with rehabilitation alone. PRP can therefore be considered a useful non-operative treatment option for athletes seeking to optimize recovery and return to sporting activity.

Declaration of patient consent: The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given the consent for his/ her images and other clinical information to be reported in the journal. The patient understands that his/ her names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Conflict of interest: Nil **Source of support:** None

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