Original Article | Journal of Orthopaedic Case Reports 2026 November:16(11):Page 471-476

Study Pain Relief and Shoulder Range of Motion after Injectable Platelet-rich Fibrin versus Platelet-rich Plasma Injection for Partial-thickness Rotator Cuff Tears: A Prospective Study

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Learning Point of the Article:

In symptomatic partial-thickness rotator cuff tears, PRP may improve shoulder function and range of motion, while I-PRF may provide greater long-term pain relief.

Abstract

Introduction: Partial-thickness rotator cuff tears are a frequent cause of persistent shoulder pain and restricted motion after failure of conservative treatment. Platelet-rich plasma (PRP) and injectable platelet-rich fibrin are autologous orthobiological treatments, but comparative evidence in partial-thickness tears is limited. This study compared pain, shoulder range of motion, and functional outcomes after PRP and injectable platelet-rich fibrin injection.

Materials and Methods: This prospective study was conducted at a tertiary teaching hospital in Andhra Pradesh, from June 2023 to December 2024. Fifty adults with magnetic resonance imaging-documented partial-thickness rotator cuff tears and persistent symptoms despite 3 months of conservative treatment were randomized equally to PRP or injectable platelet-rich fibrin. Pain and shoulder outcomes were assessed at baseline, 3 weeks, 3 months, 6 months, and 1 year.

Results: At 1 year, injectable platelet-rich fibrin had lower visual analog scale scores than PRP (median 1.5 [IQR 1.0–2.5] vs. 2.5 [1.5–3.5]; P = 0.011). PRP had higher forward flexion (170° [160–180] vs. 140° [120–160]; P = 0.002), external rotation in neutral (70° [60–90] vs. 45° [40–60]; P = 0.001), external rotation at 90° abduction (70° [60–80] vs. 50° [40–60]; P = 0.002), and internal rotation at 90° abduction (60° [50–70] vs. 40° [30–50]; P = 0.002). PRP also showed higher American Shoulder and Elbow Surgeons and University of California, Los Angeles scores and lower Shoulder Pain and Disability Index and Quick Disabilities of the Arm, Shoulder and Hand scores at 1 year.

Conclusion: Both PRP and injectable platelet-rich fibrin were associated with improvement in pain, function, and shoulder motion. In this cohort, PRP showed better long-term functional and range-of-motion outcomes, while injectable platelet-rich fibrin showed greater long-term pain reduction. The findings should be interpreted cautiously because of baseline differences in age and several shoulder motion measures and the modest sample size.

Keywords: Partial-thickness rotator cuff tear, platelet-rich plasma, injectable platelet-rich fibrin, shoulder pain, range of motion.

Introduction

Partial-thickness rotator cuff tears are an important cause of shoulder pain and functional limitation and may arise from traumatic, degenerative, or combined mechanisms. They are commonly managed initially with activity modification, analgesics, physiotherapy, and other non-operative measures,

Access this article online

Website: www.jocr.co.in

DOI: https://doi.org/10.13107/jocr.2026.v16.i11.8528

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Submitted: 14/08/2026; Review: 03/09/2026; Accepted: October 2026; Published: November 2026

DOI: https://doi.org/10.13107/jocr.2026.v16.i11.8528

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while persistent symptomatic tears may require operative treatment [1,2]. Because partial-thickness tears do not always progress to full-thickness defects, biologic treatments have attracted interest as less invasive options for patients who remain symptomatic despite conservative care [3].

Randomized trials and systematic reviews have reported improvements in pain and function after platelet-rich plasma (PRP), although the magnitude and durability of benefit vary across studies, partly because of differences in injection site, preparation methods, rehabilitation, and outcome measures [4,5]. Recent evidence continues to support a potential benefit of PRP for partial-thickness tears, but it does not establish a single optimal preparation or injection strategy [6].

Injectable platelet-rich fibrin (I-PRF) is a second-generation platelet concentrate prepared without anticoagulant and designed to remain injectable while providing a fibrin-rich matrix and a more sustained release of bioactive mediators. Comparative evidence between PRP and PRF in rotator cuff disease remains limited, and most available studies evaluate augmentation of surgical repair rather than isolated partial-thickness tears [7,8,9]. Therefore, the present study was undertaken to compare PRP and I-PRF for pain relief and restoration of shoulder range of motion (ROM) in symptomatic partial-thickness rotator cuff tears after failure of conservative treatment.

Materials and Methods

This prospective study was conducted in the Department of Orthopaedics, Sri Sathya Sai Institute of Higher Medical Sciences, Prasanthigram, Andhra Pradesh, from June 2023 to December 2024. The study protocol was approved by the Institutional Ethics Committee vide letter number SSSIHMS/IEC/2023/572 dated May 23, 2023. All participants provided written informed consent before enrolment. The study was conducted in accordance with the World Medical Association Declaration of Helsinki.

The sample size was calculated for a continuous outcome using an online statistical calculator, based on the expected standard deviation and difference to be detected. The anticipated improvement in visual analogue scale (VAS) score was assumed to be 50% in the PRP group and 60% in the I-PRF group. A value of 17 was considered in the sample-size estimation; however, its designation as the minimal clinically important difference or standard deviation requires clarification. The significance level was set at 0.05, with 90% statistical power, yielding a planned sample size of 25 participants per group (50 participants in total). The selection of a clinically meaningful difference in shoulder-related outcomes was informed by the systematic review by Su et al. (2021) [10].

Fifty adults with symptomatic partial-thickness rotator cuff tears documented on magnetic resonance imaging (MRI), with musculoskeletal ultrasonography performed as part of the diagnostic assessment, were enrolled. Eligible patients had symptoms for at least 3 months despite conservative treatment and consented to treatment with either PRP or I-PRF. Computer-generated random allocation was used to allocate 25 participants to each group.

Patients were eligible if they were adults with MRI-documented partial-thickness rotator cuff tear, persistent symptoms for 3 months despite analgesic-based conservative management, and willingness to undergo either PRP or I-PRF treatment. Patients with previous surgery of the affected shoulder, full-thickness rotator cuff tear, confounding radiculopathy, blood dyscrasia or anemia, inability to undergo MRI, inflammatory arthropathy, collagen or autoimmune disease, pregnancy, or inability to provide informed consent were excluded.

PRP was prepared from venous blood collected in acid citrate dextrose tubes. The blood was subjected to a soft centrifugation step (1500 rpm for 15 min), after which the platelet-containing plasma was transferred to a sterile tube without anticoagulant and subjected to a second, harder centrifugation. The platelet pellet was resuspended in 2–4 mL of plasma after removal of platelet-poor plasma. I-PRF was prepared by collecting 40 mL of venous blood into 10-mL plastic tubes without anticoagulant and centrifuging at 800 rpm for 4 min. The upper PRF layer was aspirated immediately before clot formation. The prepared product was administered according to the tear location using the study protocol, with immediate shoulder mobilization. A standardized rehabilitation program began after a short post-injection rest period and progressed from passive and active range-of-motion exercises to strengthening and home-based exercises.

Clinical outcomes were assessed at baseline, 3 weeks, 3 months, 6 months, and 1 year. Pain was assessed using the VAS. Functional outcomes were assessed using the American Shoulder and Elbow Surgeons (ASES) score, University of California, Los Angeles (UCLA) shoulder score, Shoulder Pain and Disability Index (SPADI), and Quick Disabilities of the Arm, Shoulder and Hand (QuickDASH). Active shoulder ROM included forward flexion, external rotation in neutral, external rotation at 90° abduction, internal rotation at 90° abduction, and cross-body adduction. Functional outcome categories were also recorded, and complications or recurrence of pain or restricted motion were documented during follow-up.

Data were analyzed using jamovi version 2.5.3. Continuous/ordinal outcomes were summarized as medians with interquartile ranges (IQR) because most variables were

Table 1: Baseline demographic and clinical characteristics

Variable	PRP (*n*=25)	I-PRF (*n*=25)	*P*-value
Age, years, mean±SD	58.0±8.5	50.2±11.1	0.018
Female, *n* (%)	9 (36)	13 (52)	0.254
Male, *n* (%)	16 (64)	12 (48)	-
VAS, median (IQR)	8 (7–9)	8 (7–8)	0.421
ASES, median (IQR)	25 (16.7–38.3)	23.3 (15–30)	0.42
UCLA, median (IQR)	14 (12–18)	12 (11–15)	0.035
SPADI, median (IQR)	61.5 (48.5–76.2)	71.5 (61.5–84)	0.065
QuickDASH, median (IQR)	75 (75–100)	75 (75–100)	0.326
Forward flexion*, median (IQR)	140 (110–150)	100 (100–130)	0.011
External rotation*, neutral	50 (30–60)	20 (10–30)	<0.001
External rotation*, 90° abduction	60 (50–70)	20 (10–30)	<0.001
Internal rotation*, 90° abduction	40 (30–60)	20 (15–20)	<0.001
Cross-body adduction*	30 (20–30)	20 (10–20)	0.001

SD: Standard deviation, IQR: Interquartile range, VAS: Visual Analog Scale, ASES: American Shoulder and Elbow Surgeons, UCLA: University of California, Los Angeles, SPADI: Shoulder pain and disability index, QuickDASH: Quick disabilities of the arm, shoulder and hand; *expressed in degrees (°)

non-normally distributed. Between-group comparisons at each time point were performed using the Mann–Whitney U test. Within-group changes over time were assessed using Friedman's test with post hoc pairwise comparisons. Categorical variables were summarized as n (%) and compared using Fisher's exact test or Chi-square test, as appropriate. Two-sided P < 0.05 was considered statistically significant.

Results

Fifty participants were randomly allocated, with 25 subjects in each group. The groups differed significantly in age: Mean age was 58.0 ± 8.5 years in the PRP group and 50.2 ± 11.1 years in the I-PRF group (P = 0.018). Sex distribution was comparable, with 16 (64%) men and 9 (36%) women in the PRP group versus 12 (48%) men and 13 (52%) women in the I-PRF group (P = 0.254). Baseline differences were also present for several shoulder motion measures, with higher median values in the PRP group, whereas baseline VAS and most functional scores were broadly comparable (Table 1).

Pain improved significantly over time in both groups. At 1 year, median VAS was 2.0 (IQR 0–4) in the PRP group and 4.0 (2–6) in the I-PRF group (P = 0.011), indicating greater pain reduction with I-PRF. The between-group difference was not significant at baseline or 3 weeks, but favored I-PRF at 3 and 6 months and at 1 year.

ROM improved significantly over time in both groups. At 1 year, PRP showed higher median forward flexion (170° [160–180] vs. 140° [120–160]; P = 0.002), external rotation in neutral (70° [60–90] vs. 45° [40–60]; P = 0.001), external rotation at 90° abduction (70° [60–80] vs. 50° [40–60]; P = 0.002), and internal rotation at 90° abduction (60° [50–70] vs. 40° [30–50]; P = 0.002). Cross-body adduction was similar at 1 year (30° [30–40] vs. 40° [30–40]; P = 0.649). Because several ROM measures were already higher in the PRP group at baseline, these unadjusted follow-up comparisons should be interpreted cautiously (Table 2).

Functional outcomes also favored PRP at 1 year. Median ASES scores were 81 (IQR 75–100) versus 68.3 (54–88; P = 0.026), UCLA scores were 34 (31–35) versus 26 (22–31; P = 0.001), SPADI scores were 11 (1.5–20) versus 30 (14–38; P = 0.008), and QuickDASH scores were 25 (0–25) versus 25 (25–50; P = 0.027) in the PRP and I-PRF groups, respectively. The proportion achieving an excellent final functional outcome was 14 (56%) with PRP and 4 (16%) with I-PRF (P = 0.006). Both groups demonstrated significant within-group improvement across follow-up (Table 3).

Table 2: Pain and shoulder range of motion at 1-year follow-up

Outcome	PRP	I-PRF	P value
VAS, median (IQR)	2 (0–4)	4 (2–6)	0.011
Forward flexion, °	170 (160–180)	140 (120–160)	0.002
External rotation, neutral, °	70 (60–90)	45 (40–60)	0.001
External rotation, 90° abduction, °	70 (60–80)	50 (40–60)	0.002
Internal rotation, 90° abduction, °	60 (50–70)	40 (30–50)	0.002
Cross-body adduction, °	30 (30–40)	40 (30–40)	0.649

Values are median (IQR). *P* values are from Mann–Whitney U tests. IQR: Interquartile range, I-PRF: Injectable platelet-rich fibrin, PRP: Platelet-rich plasma, VAS: Visual Analog Scale

Discussion

The principal finding of this randomized trial was a divergence between pain and functional recovery: I-PRF was associated with lower pain scores at later follow-up, whereas PRP was associated with better shoulder motion and functional scores. Both interventions produced

Table 3: Functional outcomes and final functional category at 1 year			
Outcome	**PRP (n=25)**	**I-PRF (n=25)**	**P value**
ASES, median (IQR)	81 (75–100)	68.3 (54–88)	0.026
UCLA, median (IQR)	34 (31–35)	26 (22–31)	0.001
SPADI, median (IQR)	11 (1.5–20)	30 (14–38)	0.008
Quick DASH, median (IQR)	25 (0–25)	25 (25–50)	0.027
Excellent final outcome,*n* (%)	14 (56)	4 (16)	0.006
Good final outcome,*n* (%)	8 (32)	8 (32)	
Fair final outcome,*n* (%)	2 (8)	8 (32)	
Poor final outcome,*n* (%)	1 (4)	5 (20)	
Values are median (IQR) or *n* (%). *P* values for continuous/ordinal outcomes are Mann–Whitney U tests; functional categories were compared using Fisher's exact test. IQR: Interquartile range, ASES: American Shoulder and Elbow Surgeons, UCLA: University of California, Los Angeles, SPADI: Shoulder pain and disability index, QuickDASH: Quick disabilities of the arm, shoulder and hand			

progressive improvement over time. This pattern is clinically relevant because pain relief and restoration of shoulder function do not necessarily occur in parallel [11,12,13]

The favorable functional and ROM findings with PRP are consistent with the broader literature. Randomized studies have reported improvement in pain and shoulder function after PRP in partial-thickness tears, although results vary according to comparator, injection site, preparation, and rehabilitation protocol [14,15]. A systematic review of randomized trials found that PRP can improve pain and functional outcomes in partial-thickness tears, particularly during short- to intermediate-term follow-up, while another recent systematic review similarly reported beneficial effects on pain and function but substantial heterogeneity among studies [16].

Recent randomized studies and meta-analyses have continued to examine PRP for partial-thickness rotator cuff tears, including comparisons with vitamin C, conservative care, and other injectables, reinforcing the heterogeneity of present evidence and the need for direct comparative trials of platelet concentrates [17,18].

The present findings also support the importance of injection location and patient selection. A recent systematic review specifically examining PRP injection sites in partial-thickness tears found that outcomes may differ between glenohumeral, subacromial, and intratendinous approaches [19]. The present protocol attempted to match administration to tear location, which may be relevant when comparing studies that use different injection targets.

The lower long-term pain scores observed with I-PRF are biologically plausible but should not be overinterpreted. I-PRF is prepared without anticoagulant and retains a fibrin-rich matrix that may support a more sustained release of bioactive mediators. However, direct clinical evidence for I-PRF in isolated partial-thickness rotator cuff tears remains sparse. Evidence comparing PRP and PRF in rotator cuff disease is stronger in surgical augmentation studies, where meta-analyses have generally favored PRP for several functional and pain outcomes [20].

Some limitations may affect interpretation. First, the sample was small (25 patients per group), limiting precision for categorical and less frequent outcomes. Second, baseline age differed significantly between groups, and the PRP group had better baseline values for several ROM measures and the UCLA score. These imbalances are important because age and baseline motion can influence recovery; therefore, the observed between-group differences at follow-up should not be interpreted as fully adjusted treatment effects.

Despite these limitations, the study provides comparative data from an Indian cohort in which both PRP and I-PRF were evaluated using multiple validated shoulder outcome measures over 1 year. The results suggest that PRP may be more useful when restoration of shoulder motion and function is the principal treatment goal, whereas I-PRF may offer an advantage for longer-term pain control. These findings require confirmation in adequately powered trials with balanced baseline characteristics and pre-specified adjusted analyses.

Conclusion

Both PRP and I-PRF were associated with clinically meaningful improvement in pain, shoulder motion, and function in adults with symptomatic partial-thickness rotator cuff tears. At 1 year, PRP was associated with better shoulder ROM and functional outcomes, while I-PRF was associated with lower pain scores. Given the small sample and important baseline differences, these findings support further adequately powered randomized trials rather than definitive claims of treatment superiority.

Clinical Message

For symptomatic partial-thickness rotator cuff tears that remain refractory to conservative treatment, both PRP and I-PRF may be considered as orthobiological options. In this cohort, PRP was associated with better long-term shoulder motion and function, whereas I-PRF was associated with greater long-term pain reduction; treatment selection should therefore be individualized until larger comparative trials provide more definitive evidence.

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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Conflict of Interest: Nil
Source of Support: Nil

Consent: The authors confirm that informed consent was obtained from the patient for publication of this article

How to Cite this Article

Dubey S, Azlam PM, Divyanshu, Usman UB, Singh A. Study Pain Relief and Shoulder Range of Motion after Injectable Platelet-rich Fibrin versus Platelet-rich Plasma Injection for Partial-Thickness Rotator Cuff Tears: A Prospective Study. J Orthop Case Rep. 2026 November;16(11):471-476. doi: 10.13107/jocr.2026.v16.i11.8528.