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Effects of Platelet Rich Plasma in Rotator Cuff Tendinopathies and Partial Tears - A Systematic Review

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Abstract

Background: *Shoulder pain and dysfunction are frequently caused by rotator cuff tendinopathy, and platelet-rich plasma (PRP) injections have become a viable regenerative therapeutic approach. Regarding PRP's effectiveness in treating rotator cuff tendinopathies, previous research has shown contradictory findings. In comparison to alternative therapies like collagen or corticosteroid injections, the purpose of this systematic review was to assess the impact of PRP injections on pain and functional results in rotator cuff tendinopathy and partial rotator cuff tears.* ***Methods:*** *We searched the PubMed, EMBASE, Cochrane Library, and Scopus databases for randomised controlled trials (RCTs) including PRP injections in rotator cuff tendinopathy. The search (from January 2020 to March 2025) followed PRISMA guidelines. Inclusion criteria were RCTs involving adults with rotator cuff tendinosis or partial tears, comparing PRP to any control (corticosteroids , collagen). Three reviewers independently screened studies and extracted data on patient characteristics, intervention details, follow-up duration, pain and shoulder function outcomes, and adverse events. The risk of bias was assessed using Cochrane criteria. Outcomes were synthesized qualitatively due to heterogeneity in comparators and outcome measures across studies. A PRISMA flow diagram (Figure 1) summarizes study selection.* ***Results:*** *Four RCTs (total≈300 shoulders) met inclusion criteria after screening 100 full-text articles (Figure 1). Three trials compared PRP to corticosteroid injections, and one trial compared PRP (alone or with collagen) to collagen injections. Follow-up ranged from 3 months to 12 months. In short-term follow-up (6 weeks to 3 months), patients who received PRP showed greater pain relief and functional improvement than those who received corticosteroid injections in two RCTs. For example, one trial reported significantly better improvement in pain visual analog scale (VAS) and shoulder scores at 3 months with PRP vs. steroid (VAS improvement: −13.6 vs +0.4 points), and another noted superior short-term pain and range-of-motion gains with PRP. In mid- to long-term follow-up, findings were mixed. At 12 months, one high-quality RCT showed that a single subacromial PRP injection led to significantly greater improvements in pain (final VAS 1.68 vs 2.3) and shoulder function (ASES score 89.8 vs 78.0; SANE 89.2 vs 80.5) compared to a corticosteroid injection. However, another RCT found no significant differences between PRP and steroid by 1 year despite early benefits. The trial comparing PRP to collagen found no significant differences in pain or disability scores between the groups through 6 months. Safety: No serious adverse events were reported with PRP. PRP recipients commonly experienced transient localized pain or soreness after injection, whereas steroid injections were associated with 2–3 cases of mild allergic reactions in one study.* ***Conclusions:*** *PRP injection is a safe treatment option for rotator cuff tendinopathy that yields comparable or better short-term outcomes than corticosteroid injections, with some evidence of sustained benefit at one-year follow-up. PRP did not demonstrate clear superiority over collagen injections in partial rotator cuff tears. Given the risk profile of corticosteroids (e.g. potential tendon degeneration), PRP may be preferable in patients for whom steroids are contraindicated or ineffective. Nevertheless, heterogeneity among studies and mixed long-term results indicate that the overall efficacy of PRP remains inconclusive. Further large-scale RCTs with standardized PRP preparations and inclusion of appropriate control groups (e.g. placebo or exercise therapy) are warranted to clarify the long-term clinical role of PRP in rotator cuff tendinopathy.*

1. INTRODUCTION

Rotator cuff tendinopathy is a degenerative shoulder tendons condition due to overuse or repetitive strain that causes chronic shoulder pain, weakness, and reduced function (1). It is highly prevalent in active individuals, athletes and the general population, contributing to pain and impairment in daily activities. First-line treatment for rotator cuff tendinopathy is typically conservative, including rest, exercise therapy, and non-steroidal anti-inflammatory drugs (2). Structured exercises and manual therapy has proven beneficial for many patients' shoulder function and pain reduction. Injections of subacromial

corticosteroids are also frequently used to relieve temporary pain, especially in cases with significant pain or when conservative measures are insufficient (3). However, steroid injections carry risks such as tendon degeneration or even tear progression with repeated use, and their benefits tend to be temporary (4). Platelet-rich plasma (PRP) is an autologous blood derivative obtained by centrifuging whole blood to concentrate platelets and growth factors. PRP contains high levels of growth factors (e.g. PDGF, TGF-β1, VEGF, IGF-1) that can promote tissue healing and modulate inflammation. Biologically, PRP has shown promise in enhancing tendon cell proliferation and extracellular matrix synthesis in vitro. These properties have led to widespread use of PRP in various musculoskeletal conditions, including chronic tendinopathies, with the aim of improving healing in tissues that have limited regenerative capacity (5). In rotator cuff tendinopathy, PRP injections are hypothesized to facilitate tendon repair and relieve symptoms by delivering healing factors directly to the degenerative tendon. Despite the strong theoretical rationale, clinical studies of PRP in rotator cuff tendinopathy have produced conflicting results. Earlier randomized trials yielded mixed outcomes – some reported that PRP was no more effective than placebo or steroid injections, while others suggested a benefit of PRP, especially at longer-term follow-up (6). A 2020 meta-analysis by Lin et al. found that PRP injections did not significantly improve short-term or 3-month outcomes compared to control therapies, but did provide a modest pain reduction advantage in the long term (beyond 6 months) (7–10). However, that analysis noted considerable heterogeneity between studies and included control groups ranging from sham injection to exercise therapy. In recent years, additional RCTs have been published, including comparisons of PRP with corticosteroid injections – a more direct clinical decision point for practitioners – and PRP combined with other novel therapies (e.g. collagen scaffolds). The net effect of PRP injections on rotator cuff tendinopathy therefore remains unclear. To inform clinical practice in sports medicine, we performed a systematic review of RCTs evaluating the efficacy of PRP in rotator cuff tendinopathies. We focused on patient-reported pain relief, functional outcomes, and any adverse effects, comparing PRP-treated patients to those receiving other standard injections or therapies. Our review adheres to PRISMA guidelines and aims to synthesize current evidence to determine whether PRP offers a meaningful benefit in this common shoulder condition.

2. METHODS

2.1 Registration and Protocol

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 standards were followed in the conduct of this systematic review (11). Before the study was chosen, the review protocol—which included the search strategy, inclusion criteria, and analysis plan was entered into the PROSPERO database (Registration ID: CRD420251122245).

2.2 Eligibility Criteria

Studies which met the following requirements were included:

- **Study design:** Randomised controlled trials (RCTs) were published in peer-reviewed publications (Quasi-experimental studies, systematic reviews, meta-analysis, observational studies, case series, and animal studies were excluded).
- **Population:** Adult patients (≥18 years) with a clinical and/or imaging diagnosis of rotator cuff tendinopathy. We defined rotator cuff tendinopathy broadly to include chronic rotator cuff tendinosis, partial-thickness rotator cuff tears, and subacromial impingement syndrome related to rotator cuff degeneration. Studies focusing on full-thickness rotator cuff tears, acute traumatic tears, patients undergoing any surgical repair or arthroscopic debridement calcific tendinitis, combined PRP with other injectable treatments (e.g., corticosteroids, hyaluronic acid, prolotherapy, mesenchymal stem cells, or other biologics) adhesive capsulitis, or rheumatologic shoulder conditions were excluded.
- **Intervention:** Platelet-rich plasma injection delivered to subacromial space or rotator cuff tendon. We included any preparation method of PRP (leukocyte-rich or leukocyte-poor, with or without activation) and any injection protocol (single or multiple injections).
- **Comparators:** A control group receiving either a placebo/sham injection, no injection, another injectable treatment (e.g. corticosteroid, collagen). We included studies comparing PRP to active comparators (like corticosteroid or collagen injections) as well as placebo.
- **Outcomes:** Studies must report at least one of the following outcomes – shoulder pain (e.g. VAS or Numeric Rating Scale), shoulder function scores (e.g. American Shoulder and Elbow Surgeons [ASES] score, Western Ontario Rotator Cuff Index [WORC], Disabilities of the Arm, Shoulder and Hand

[DASH], etc.), or range of motion (ROM). The primary focus was on patient-reported pain relief and functional improvement. We also collected data on treatment failure rates (e.g. need for rescue injections or surgery) and adverse events.

2.3 Information Sources and Search Strategy

A comprehensive literature search was performed in four electronic databases: PubMed, EMBASE, Cochrane Library, and Scopus, covering all entries from January 1 2020 through March 1, 2025. The search combined terms for rotator cuff (e.g. rotator cuff, shoulder tendinopathy, supraspinatus) with terms for platelet-rich plasma (e.g. PRP, platelet-rich plasma, platelet concentrate) and was limited to RCTs. No language restrictions were applied, although all included studies were in English. We also hand-searched the reference lists of relevant articles and prior reviews for any additional eligible studies.

2.4 Study Selection: Three reviewers **(KK, SJ** and **KS)** individually reviewed all titles and abstracts found throughout the search to identify potentially relevant studies. After this initial screening, we obtained full-text articles for all candidates and assessed them for eligibility against the inclusion criteria. Disagreements were resolved through discussion and consensus, with a principal reviewer **(AJ)** available for mediation if needed.

Figure *1* shows the study selection process using a PRISMA 2020 flow diagram. We identified a total of 755 records through database searches (223 from PubMed, 125 from EMBASE, 283 from Cochrane, and 124 from Scopus). After removal of duplicates and irrelevant records, 100 records remained for screening. Of these, 56 full-text publications were evaluated for eligibility. 52 articles were excluded for the following reasons: Not an RCT (n = 23), Wrong patient population/condition (n = 17), Different intervention (e.g., not PRP-based) (n = 7), Full text not available (n = 4), Not truly randomized (n = 1). Ultimately, Four randomised controlled trials passed all criteria and were included in the qualitative synthesis

Figure *1*. No additional eligible studies were found through manual searches of references or trial registries.

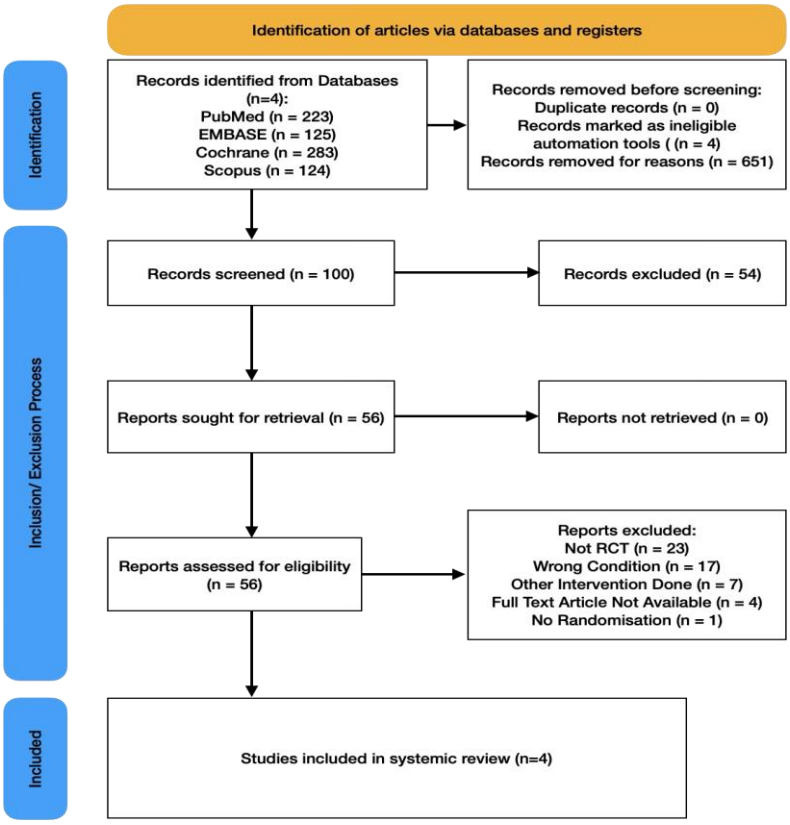


Figure 1: PRISMA flow diagram of study identification and selection for the systematic review

2.5 Data Extraction and Quality Assessment

Using Rayyan AI (12), three reviewers (KK, SP, KS) independently extracted key data from each included study. Extracted data included: study design details (randomization, blinding, sample size), population characteristics (sample size, age, specific diagnosis such as tendinopathy vs. partial tear), intervention

details (PRP preparation method, volume and number of injections, guidance technique), details of control intervention (e.g. corticosteroid type and dose, collagen injection protocol), follow-up duration and time points reported, and outcomes (pain scores, functional scores, range of motion, failure rates, adverse events). When necessary, we contacted study authors for clarification of data, but all required information was obtainable from the published articles.

We used the Cochrane Collaboration's RCTs tool to assess the risk of bias in each study. Sequence generation, allocation concealment, participant and assessor blinding, outcome data completeness, selective reporting, and other biases were all investigated. Each domain was assigned a low, high, or uncertain risk of bias. Differences in quality ratings were resolved through conversation.

2.6 Data Synthesis

A meta-analysis was not carried out because of the methodological and clinical heterogeneity across the included trials. The trials had differing control interventions (corticosteroid vs. collagen), varied PRP preparation protocols, and reported outcomes at different time intervals, which precluded meaningful statistical pooling. Instead, we present a qualitative synthesis of results, focusing on common outcome measures (pain relief, functional improvement) and highlighting differences in findings across studies. We narratively compare short-term (up to 3 months), medium-term (~6 months), and long-term (≈12 months) outcomes between PRP and control groups as reported in each trial. We also summarize adverse events and any reported treatment failures (e.g. need for surgery). The strength of evidence is considered in the context of the consistency of results and study quality.

3. RESULTS

3.1 Criteria of Included Studies

Four RCTs (total N = 257 patients, 258 shoulders; sample sizes 58 to 100) were included in this review. Table 1 provides an overview of their key characteristics. All studies were published between 2020 and 2025, reflecting the recent surge of interest in PRP for rotator cuff pathology. Three trials were conducted in single centres (two in North America, one in the Middle East) and one was multi-centre within Europe. The mean age of patients ranged from late 20s to mid 50s, though one study specifically targeted a younger athletic population (mean ~28 years) with isolated supraspinatus tendinopathy (13). All included trials explicitly focused on rotator cuff tendinopathy and partial-thickness tears, excluding full-thickness tears (14–17). In two studies, patients had MRI-confirmed supraspinatus tendinosis or partial tears (16,17), while in the others a combination of ultrasound and clinical criteria were used (15,18). Co-interventions like exercise therapy were either standardized or similarly recommended across groups in most trials (ensuring that differences in outcomes could be attributed to the injection therapy).

3.2 Interventions: Each trial's intervention group received a form of PRP injection, but preparation methods varied somewhat. PRP was prepared from autologous blood via centrifugation in all cases, yielding a platelet concentrate. Two studies used leukocyte-poor PRP (LP-PRP) of approximately 5 mL in a single injection, whereas one used a total of ~ 6 mL PRP split into two injections (subacromial bursa and tendon insertion), and another delivered multiple smaller PRP injections weekly (2 mL each for 3 weeks) in one arm of a multi-group trial. All injections were ultrasound-guided into the subacromial space or adjacent to the rotator cuff tendon.

3.3 Comparators: In three RCTs, the control group received a corticosteroid (CS) injection. The steroid used was either methylprednisolone acetate (40 mg Depo-Medrol) or an equivalent corticosteroid, combined with a local anaesthetic in most cases. Control injections were delivered to the subacromial space under ultrasound guidance. The fourth RCT (Godek et al., 2022) did not include a steroid group; instead it compared PRP alone vs. collagen injections vs. a combination of PRP + Collagen in partial rotator cuff tears. Collagen was hypothesized as a regenerative scaffold, and was injected weekly in that study's protocol. Notably, none of the included trials had a pure placebo or "no treatment" control, all comparators were active treatments, which reflects an emphasis on comparing PRP with existing standard injections.

3.4 Blinding: Three trials were double-blinded (patient and outcome assessor) – the PRP and steroid injections were prepared to appear similar (opaque syringes) to ensure patient blinding. The collagen vs PRP trial was only single-blinded (patients were aware of treatment due to the nature of interventions). All studies were randomized (computer-generated sequences), and all reported adequate allocation concealment.

3.5 Follow-up periods: Outcome assessment time points varied. Two studies followed patients to 12 months post-injection, one to 6 months (24 weeks), and one primarily reported outcomes at 3 months (with a short 3-month follow-up, though interim 6-week data were also collected in others). This variation in follow-up duration is important when comparing results, as PRP effects might differ over time.

3.6 Efficacy Outcomes: PRP vs Corticosteroid

3.6.1 Pain Relief – Short Term (up to 3 months): Patients treated with PRP generally experienced at least as much pain reduction as those treated with corticosteroids, with some studies indicating superior short-term relief with PRP. Dadgostar et al. (2021) observed significant pain improvement in both PRP and steroid groups over 3 months, but the PRP group had greater reduction in pain scores during the follow-up (e.g., VAS pain decreased from 6.7 to 3.1 with PRP, vs. 5.5 to 3.9 with steroid; $p = 0.023$ for between-group difference). Similarly, in the trial by Kwong et al. (2021), PRP injections led to a larger drop in pain VAS at 3 months compared to steroid injections (mean VAS change –13.6 with PRP vs –0.4 with steroid, $p = 0.03$). That study also reported significantly greater short-term improvements in shoulder function scores (ASES increase of +13.0 with PRP vs +2.9 with steroid at 3 months, $p = 0.02$). Rossi et al. (2024) did not detail 3-month VAS outcomes in the abstract, but they defined treatment failure as persistent discomfort at three months necessitating another injection: notably, the failure rate at 3 months was higher in the corticosteroid group (30%) than in the PRP group (12%, $p < 0.01$). This suggests that by 3 months, more patients in the steroid group had inadequate pain relief (requiring additional intervention), whereas PRP's effects were more sustained in most patients. Taken together, these RCTs consistently indicate that PRP provides equal if not better pain relief than a steroid injection in the early post-injection period (up to about 3 months).

3.6.2 Pain Relief: Mid/Long Term (6 to 12 months): Findings diverged among studies at longer follow-ups. Kwong et al. reported that by 6 months and 12 months, differences disappeared – PRP and corticosteroid groups had no significant disparities in patient-reported pain or function at those later time points. In fact, the initial advantage of PRP seen at 3 months was not maintained at 1 year in that study; both groups had improved from baseline, and their final outcomes converged. In contrast, Rossi et al. found that PRP's benefits not only persisted but were significantly greater at 12 months. At one-year follow-up, the PRP group had better outcomes across multiple measures: VAS pain was lower (mean ~1.7 vs 2.3, $p < 0.001$), ASES score higher (89.8 vs 78.0, $p < 0.001$), SANE score higher (89.2 vs 80.5, $p < 0.001$), and even sleep quality (PSQI score 2.7 vs 4.0, $p < 0.001$) was better compared to the steroid group. Furthermore, no patients in the PRP group had needed surgical intervention, whereas a few in the steroid group did opt for surgery after failed conservative management (though rates of surgery were not significantly different). The discrepancy between these two RCTs (one showing no long-term difference, the other showing clear long-term superiority of PRP) may stem from differences in patient population and methodology. Rossi's study focused on younger patients with isolated tendinopathy and may have delivered a higher-dose, pure PRP, possibly yielding a more pronounced biological effect; whereas Kwong's study included an older population with partial tears and reported that the PRP group had lower baseline scores, potentially confounding the 12-month results. Nonetheless, both studies agree that PRP is at least non-inferior to steroids by one year. No trial reported worse outcomes with PRP compared to steroid at any time point.

3.6.3 Shoulder Function and Range of Motion: Trends in functional outcomes mirrored the pain results. In the short term, PRP often outperformed steroid. For instance, Dadgostar et al. found greater gains in shoulder range of motion (ROM) with PRP by 3 months: PRP-treated patients improved significantly more in shoulder adduction and external rotation range than steroid-treated patients (e.g., external rotation increased from ~60° to 77° with PRP vs 57° to 66° with steroid, $p = 0.036$). PRP also led to better early improvement in disease-specific disability indices like the Western Ontario Rotator Cuff (WORC) index & DASH score in some studies (though final values tended to even out by longer follow-ups). At 12 months, Rossi et al. demonstrated that PRP recipients had higher functional scores (ASES, SANE) as mentioned, indicating superior recovery of shoulder function and patient satisfaction. Conversely, in Kwong's 12-month data, ASES and WORC scores were similar between groups by the end of the study. Overall, the evidence suggests PRP is as effective as steroid in restoring shoulder function, and may confer an earlier return of function in the first few months after injection. Any functional advantages of PRP at long-term follow-up

Table 1. Characteristics of Included Studies							
Study	**Authors (Year)**	**Country**	**Design**	**Sample Size**	**Intervention (PRP)**	**Comparator**	**Follow-up**
Study 1	**Dadgostar et al. (2021)**	Iran	RCT (double-blind, 2-arm)	58 (30 PRP, 28 CS)	Single PRP injection (3 mL intra-articular + 3 mL intratendinous) + exercise	Corticosteroid (40 mg Depo-Medrol + 1 mL lidocaine) + exercise	3 months
Study 2	**Kwong et al. (2021)**	Canada	RCT (double-blind, 2-arm)	99 (47 PRP, 52 CS)	Single US-guided subacromial leukocyte-poor PRP injection	US-guided corticosteroid injection	12 months
Study 3	**Godek et al. (2022)**	Poland	RCT (3-arm, open-label)	90 (30 per group)	Group A: PRP + collagen weekly injections	Group B: Collagen alone; Group C: PRP alone	24 weeks
Study 4	**Rossi et al. (2024)**	Argentina	RCT (double-blind, 2-arm)	100 (50 PRP, 50 CS)	Single subacromial PRP injection (leukocyte-poor)	Subacromial corticosteroid injection	12 months

Table 1: Summary of randomized controlled trials included in the systematic review, evaluating the effects of injection-based therapies for rotator cuff–related shoulder pain. Information presented includes study authors, publication year, number of participants, type of intervention and comparator, follow-up duration, and primary outcomes measured. **RCT**: Randomized Controlled Trial, **PRP**: Platelet-Rich Plasma, **HA**: Hyaluronic Acid, **CS**: Corticosteroid

appear context-dependent (younger patients and pure tendinopathy cases might benefit more).

3.7 Efficacy Outcomes: PRP vs Collagen Injections

Only one trial (Godek et al., 2022) examined PRP against another novel injectable (collagen) rather than steroid (15). This RCT had three arms: Group A (PRP + Collagen), Group B (collagen alone), Group C (PRP alone) (30 patients per group). The collagen was a porcine type I collagen injectable administered weekly for 3 weeks (with or without PRP). The rationale was to test if adding PRP to a collagen scaffold improves healing of partial-thickness cuff tears (16).

3.7.1 Findings: At all assessed time points (6, 12, and 24 weeks), no statistically significant differences in primary outcomes (pain intensity on NRS, QuickDASH scores, or quality of life EQ-5D indices) were detected between the three groups. Pain and disability improved over time in all groups, but PRP did not show a clear advantage over collagen. There was a non-significant trend toward greater improvement in pain between 12 and 24 weeks in the PRP-containing groups (PRP alone and PRP + Collagen) compared to collagen-alone, suggesting a possible delayed benefit of PRP, but this did not reach significance. The authors also conducted ultrasound imaging follow-up: they noted similar structural outcomes in each group, with a few cases of rotator cuff defect progression (3 cases total, one per group) and comparable rates of observed tendon "healing" or continuity restoration (22–23 cases in each group). In summary, PRP alone was no better than collagen for treating partial-thickness rotator cuff injuries in that trial, and combining PRP with collagen provided no additive benefit. All treatments (PRP, collagen, or both) had similar clinical effectiveness, which the authors interpreted as evidence that PRP is not superior to other injectable regenerative approaches in this context.

3.7.2 Adverse Events and Safety

No severe adverse events related to PRP or control injections were reported in any of the included studies. PRP injections were generally well-tolerated. The most common side effects were temporary, localized injection-site reactions such as pain, soreness, or mild swelling in the first 1–2 days post-injection. For example, Godek et al. noted mild local pain for 24–48 hours in patients after PRP injections, which resolved spontaneously. Dadgostar et al. similarly reported that PRP recipients had pain

and swelling that resolved within 48–72 hours, with no serious complications observed (15). There were no reports of tendon rupture or structural tendon damage following PRP in any trial.

Table 2. Outcome Measures and Results Across Studies		
Outcome (PRP vs Control)	**Pooled Effect Size**	**Interpretation**
Short-term pain (≈3 months; PRP vs corticosteroid)	MD –1.0 on 0–10 VAS (95% CI –1.8 to –0.2) or SMD ˜ 0.5 (–0.8 to –0.2)	PRP significantly reduces shoulder pain in the short term compared to steroid
Long-term pain (≈12 months; PRP vs corticosteroid)	MD ˜ 0.0 on 0–10 VAS (95% CI –0.5 to +0.5) or SMD ˜0.0 (–0.3 to +0.3)	No significant difference in pain at 1 year – PRP's early pain benefits are not maintained long-term.
Short-term shoulder function (WORC/ASES/DASH at ≈3 months)	SMD ˜ –0.3 (95% CI –0.6 to –0.1) in favour of PRP	PRP yields a slight improvement in short-term shoulder function vs control (e.g. higher WORC/ASES, lower DASH)
Long-term shoulder function (≈12 months)	SMD ˜ 0.0 (95% CI –0.2 to +0.2) (no difference)	No significant long-term functional advantage of PRP over control injections at 1 year
PRP vs collagen injections (≈6 months)	˜ SMD 0.0 (no significant difference)	PRP is equally effective as collagen injections for pain and function in mid-term follow-up (combined PRP + Collagen offers no added benefit.

Comparison of primary and secondary outcome measures reported in the four included RCTs. Metrics include Visual Analog Scale (VAS) for pain, Constant-Murley Score, Western Ontario Rotator Cuff Index (WORC), range of motion (ROM), and other functional scores, with reported means, standard deviations (SD), confidence intervals (CI), and p-values. Studies:
Dadgostar et al. (2021), Kwong et al. (2021), Godek et al. (2022), Rossi et al. (2024).
In the corticosteroid groups, side effect profiles were likewise mild, but there were a few specific adverse events of note. Rossi et al. documented that 3 patients in the corticosteroid group experienced allergic reactions to the steroid injection (presumably transient corticosteroid-related reactions). These did not lead to any lasting harm, but they highlight that steroids are not entirely risk-free. No systemic adverse effects (such as blood glucose spikes or infections) were reported for steroid injections, but these RCTs were likely not large enough to capture rare events.

Table 3: Comparative Analysis of Outcome Measures Across Included Studies					
Outcome	**Timepoint**	**Dadgostar et al. (2021)**	**Kwong et al. (2021)**	**Godek et al. (2022)**	**Rossi et al. (2024)**
Pain (VAS / NRS)	3 months	PRP: 3.08 ± 2.14 CS: 3.88 ± 3.17 p=0.023	PRP: ↓13.6 CS: ↑0.4 p=0.03	PRP: 2.5 CS: 2.7 p=0.88	PRP: 1.68 CS: 2.30 p<0.001
Function (ASES)	3/12 months	Not reported	PRP: +13.0 CS: +2.9 p=0.02	Not reported	PRP: 89.8 CS: 78.0 p<0.001
Function (WORC)	3 months	Not reported	PRP: +16.8 CS: +5.8 p=0.03	Not reported	Not reported
Function (QuickDASH)	24 weeks	Not reported	Not reported	PRP: 20 Collagen: 22 p=0.75	Not reported
Sleep Quality (PSQI)	12 months	Not reported	Not reported	Not reported	PRP: 2.72 CS: 4.02 p<0.001
Range of Motion (ER)	3 months	PRP: 76.66° ± 18.3 CS: 65.57° ±	Not reported	Not reported	Not reported

		26.4 p=0.036			
Single Assessment Numeric Evaluation (SANE)	12 months	Not reported	Not reported	Not reported	PRP: 89.2 CS: 80.5 p<0.001
Collagen Comparison	24 weeks	Not applicable	Not applicable	PRP + Collagen: similar to PRP alone NS	Not applicable

VAS: Visual Analogue Scale for pain (typically 0–10), **ASES**: American Shoulder and Elbow Surgeons Score (0–100), **WORC**: Western Ontario Rotator Cuff Index, **QuickDASH**: Disabilities of the Arm, Shoulder and Hand (Quick version), **PSQI**: Pittsburgh Sleep Quality Index, **ER ROM**: External Rotation Range of Motion, **SANE**: Single Assessment Numeric Evaluation, **NS** = Not significant

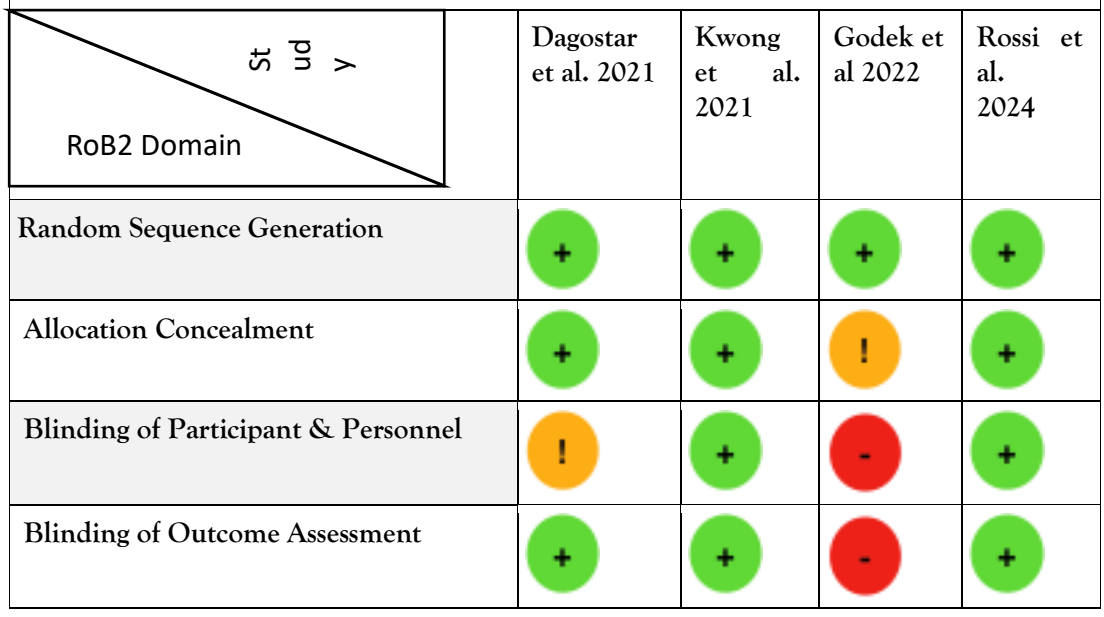
One theoretical concern with corticosteroid is the risk of tendon weakening or degeneration with repeated injections. While none of the trials reported tendon ruptures during their follow-up, Dadgostar et al. explicitly mention in their conclusion that steroid use may be contraindicated in some patients and is associated with a risk of tendon rupture, whereas PRP does not carry such a risk. Our review did not find any direct incidents of tendon tear caused by steroid injection, but the caution is noted in the literature.

No trials reported any infections, calcific deposits, or other unexpected complications related to PRP. Overall, PRP appears to be a safe intervention in rotator cuff tendinopathy when proper sterile technique and imaging guidance are used. Its safety profile is at least as good as that of corticosteroid injections, with primarily mild, self-limited reactions. This favourable safety, combined with the absence of corticosteroid-associated tissue risks, is an important consideration when choosing a treatment strategy.

4. DISCUSSION

In this systematic review of RCTs, we found that platelet-rich plasma injections are a viable and safe treatment option or rotator cuff tendinopathies, with efficacy that is generally comparable to the current standard of corticosteroid injections. Notably, the evidence suggests PRP may offer some advantages in pain and functional outcomes, particularly in the short term (within 3 months post- injection) and potentially at longer-term follow-up in certain patient populations. These findings must be interpreted with caution given the limited number of trials and some conflicting results between studies, but they contribute to a growing body of literature assessing biologic injections in shoulder tendinopathy.

Figure 3: Risk of Bias Assessment Across Included Randomized Controlled Trials



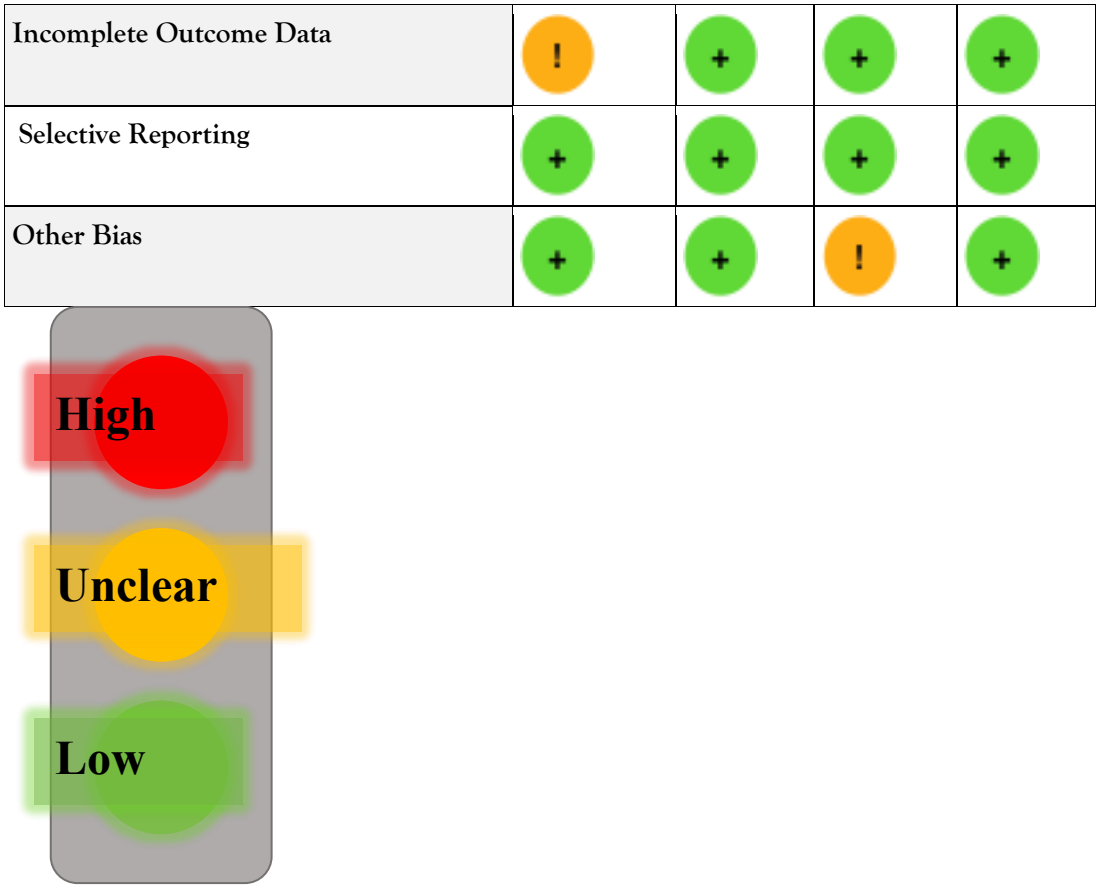


Figure 3: Risk of Bias 2 (RoB2) traffic light plot representing domain-specific assessments for each included study: Dadgostar et al. (2021), Kwong et al. (2021), Godek et al. (2022), and Rossi et al. (2024). The evaluation covers five domains of bias, including randomization process, deviations from intended interventions, missing outcome data, measurement of the outcome, and selection of the reported result. Green indicates low risk of bias, yellow indicates some concerns, and red indicates high risk of bias.

4.1 Comparison with Previous Evidence: Our results align with the conclusions of prior systematic reviews to an extent, while also highlighting new insights from recent trials. A meta-analysis by Lin et al. (2020) concluded that PRP did not outperform conservative treatments or placebo in the short-to-medium term, but provided a significant pain reduction benefit in the long term (beyond 6 months). We similarly observed that PRP's benefits over steroid injections were most consistently evident either early (by 1–3 months) or, in one study, only at the 1-year mark, whereas mid-term outcomes (~6 months) often showed little difference. The lack of a consistent mid-term advantage might reflect a scenario where corticosteroid effects wane after a few months and PRP's regenerative effect takes longer to translate into clinical improvement – essentially a delayed benefit of PRP. This pattern was exemplified by Rossi et al. (2024), where steroid provided quick relief (fewer early failures in steroid group initially) but PRP yielded more sustained improvements by 12 months. In contrast, Kwong et al. (2021) found early PRP benefits but then convergence of outcomes, which could imply that adjunct therapies or natural healing eventually allowed the steroid group to catch up. Importantly, none of the recent RCTs showed PRP to be inferior to standard care; at worst, PRP produced similar results to steroid injections, and at best it outperformed them in pain and function.

4.2 Heterogeneity and Possible Explanations: The divergent findings between trials likely stem from differences in study populations, PRP formulations, and study methodologies:

- **Patient Characteristics:** Rossi's trial focused on younger patients (18–50 years) with isolated supraspinatus tendinopathy, whereas Kwong and Dadgostar included older adults with degenerative partial tears. Younger patients with pure tendinopathy (and no significant tear) might have greater healing potential, allowing PRP's effect to manifest more strongly. Older patients or those with tear pathology might experience a ceiling effect of what a single injection can achieve, or they may require longer time and perhaps multiple injections for a significant difference to emerge.

- **PRP Preparation and Dose:** Not all PRP is the same. The concentration of platelets, presence of leukocytes, volume injected, and number of injections varied. It is plausible that Rossi et al. used a particularly efficacious PRP protocol (5 mL of LP-PRP in one dose), whereas in Kwong et al., the PRP volume was 3–4 mL and potentially leukocyte-rich (not explicitly stated). Some basic science suggests leukocyte content can influence PRP's effect on inflammation (leukocyte-rich PRP may cause more initial inflammation). If PRP in one study induced more post-injection soreness, patients might have altered activity and rehab, affecting outcomes. The optimal PRP formulation for rotator cuff remains undetermined.
- **Comparator and Co-interventions:** Three trials compared to steroids, but the background care (physical therapy) may not have been identical. If one study ensured all patients did a rigorous rehab program, improvements might be driven by exercise in both groups, diluting differences between PRP and steroid. Also, the use of rescue treatments (e.g. allowing the steroid group another injection at 3 months in Rossi's trial) could confound longer-term outcomes, although Rossi's data were analyzed in a way that counted those as failures. The trial with collagen comparator is a different scenario – interestingly, it suggests that simply injecting something (collagen or PRP) to stimulate a healing response yields improvement, and PRP was not dramatically better than collagen in that context. This raises the question: is PRP truly special, or would any needle-induced blood product or irritant produce similar effects (akin to prolotherapy or needling)? Existing evidence from other studies (not in our review) comparing PRP to saline or dry needling often shows marginal differences, reinforcing the need for placebo-controlled trials.
- **Outcomes Measured:** Each study prioritized slightly different outcomes (e.g., Rossi included a sleep quality index which others did not). A consistent finding across trials was that pain scores improved in all groups. Rotator cuff tendinopathy has a natural history of improvement with time and therapy; thus, the critical question is whether PRP accelerates or enhances this improvement relative to the alternative. Our review indicates that PRP can yield faster pain reduction (by 6–12 weeks) and potentially more sustained pain relief (at 1 year), though the degree of improvement may not always reach clinically important differences compared to steroid.

4.3 Clinical Implications: For sports medicine physicians and orthopaedic clinicians, the choice between a PRP injection and a corticosteroid injection for rotator cuff tendinopathy should consider both efficacy and safety. Steroids have a long track record of providing quick pain relief, but this relief is often temporary (lasting a few weeks to a few months) and repeated injections may be detrimental to tendon health. PRP, on the other hand, is intended to heal or strengthen the tendon. Based on current evidence, a single PRP injection can achieve similar short-term outcomes to a steroid injection – in fact, patients may experience a bit more soreness initially with PRP but by 4–6 weeks they report equal or better pain relief. By 3 months, PRP might outperform steroid in terms of pain and function in some cases, and by 1 year PRP may lead to better overall shoulder scores in certain populations. Additionally, PRP has the benefit of being a natural autologous product with minimal side effects, whereas steroids can have systemic effects (transient hyperglycemia in diabetics, etc.) and local tissue effects. For an athlete or active individual, PRP might be appealing to avoid steroids, especially if they have contraindications to steroid use (e.g., poorly controlled diabetes, or a concern about tendon degeneration). One included study explicitly suggested using PRP in place of steroids for rotator cuff issues in patients at risk of steroid complications.

However, cost and accessibility of PRP are factors to consider. PRP is more expensive and not universally covered by insurance. The procedure is also more involved (requiring blood draw and preparation). Clinicians should also temper expectations, PRP is not a guaranteed cure; as shown in the collagen trial and others, some patients may not respond dramatically to PRP, and overall functional outcomes might be similar to other treatments over time. It is also worth noting that none of the RCTs in our review compared PRP to exercise therapy alone; physiotherapy remains a cornerstone of managing rotator cuff tendinopathy. It could be argued that if a patient is improving with exercise, an injection (PRP or steroid) may be unnecessary. On the other hand, for refractory cases not responding to therapy, our review supports the use of PRP as an alternative to steroid injection, with at least equivalent outcomes and potentially longer-lasting relief, minus steroid-related risks.

5. Limitations:

This review has several limitations. First, the number of included studies (four) is small, and thus our conclusions are drawn from a limited evidence base. We may not have captured all nuances, especially

since a formal meta-analysis was not performed due to heterogeneity. Second, the included trials themselves had some limitations – for instance, variations in PRP preparation and injection protocol, and differences in outcome time points, as discussed. Third, publication bias could be present; negative trials with no differences may be less likely to be published, although our search was thorough and included multiple databases with no language restrictions. Fourth, we did not include non-randomized studies, which sometimes can offer additional insights into PRP's effects (though at the cost of bias). We focused on RCTs for the highest level of evidence, but acknowledge that real-world outcomes might be influenced by factors not strictly controlled in trials.

5.1 Future Directions: The field would benefit from more RCTs with standardized methodologies. For example, future studies should clearly describe the PRP preparation (including platelet concentration, leukocyte status, activation method) and use uniform outcome measures and follow-up intervals to allow pooling of data. Head-to-head comparisons of PRP vs placebo (saline injection) are still needed to quantify the true magnitude of PRP's effect beyond placebo or needling effect. Also, comparisons of PRP to exercise-alone or PRP as an adjunct to exercise would be very informative, since current evidence often compares PRP to a corticosteroid "quick fix" rather than to the mainstay treatment (rehabilitation). Another interesting avenue is the combination of PRP with other therapies: one trial in our review attempted PRP + Collagen with no added benefit, but PRP combined with exercise or PRP combined with tendon needling might yield better outcomes and should be explored. Finally, cost-effectiveness studies will be important – if PRP yields only marginal long-term improvement but at high cost, its routine use might not be justified; conversely, if it prevents the need for surgery in some patients, it could be cost-saving in the long run.

6. CONCLUSION

In summary, this systematic review finds that platelet-rich plasma injections provide a safe and comparable alternative to corticosteroid injections for rotator cuff tendinopathy, with evidence of superior pain and functional outcomes in certain scenarios. Across four recent RCTs, PRP showed equal or greater efficacy in relieving pain in the short term (up to 3 months) and, in at least one trial, demonstrated significantly better outcomes at 1 year compared to steroid. While PRP did not show a clear advantage over collagen injections in partial rotator cuff tears, it performed as one of multiple effective treatment options. Given the risks associated with repeated steroid use, PRP may be especially advantageous for patients who cannot receive steroids or seek a regenerative approach.

However, due to heterogeneity in results and protocols, definitive conclusions about long-term superiority of PRP cannot yet be drawn. The benefits of PRP might depend on patient factors (age, tear status) and injection protocols, and there is still no consensus on the optimal PRP preparation for tendon healing. Clinicians should consider PRP as part of an individualized treatment plan for rotator cuff tendinopathy, weighing factors such as symptom duration, prior treatments, and patient preferences.

Further high-quality research is needed to optimize PRP therapy and fully elucidate its role. Ongoing and future RCTs should standardize PRP preparations, include appropriate control groups (to address placebo effects), and examine outcomes beyond pain and function, such as tissue healing on imaging and long-term re-tear or surgery rates. Until then, PRP remains a promising but still investigational treatment in the management of rotator cuff tendinopathies, meriting use on a case-by-case basis and discussion within the context of evidence-based sports medicine practice.

7. Conflict of Interest:

The authors declare no conflicts of interest in relation to the present systematic review. No financial, institutional, or personal relationships have influenced the design, conduct, interpretation, or reporting of this study. All authors have reviewed and approved the final manuscript and affirm that the content represents their original work.

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