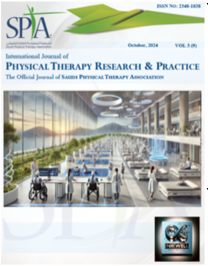

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Review Article

Platelet-Rich Plasma for Musculoskeletal Disorders: A Critical Review of Therapeutic Evidence and Clinical Utility

Mohamed Merza Alrayes[1]*

[1.] Physical Therapy Department, Primary Healthcare Centers, Manama, Bahrain.

*Corresponding Author: phd.mmkrayes@hotmail.com

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Abstract

Objective: Platelet-Rich Plasma (PRP) therapy has emerged as a prominent modality in musculoskeletal medicine due to its autologous nature and potential to enhance tissue healing through growth factor release. Although widely adopted, clinical outcomes exhibit variability across studies. Therefore, this review critically evaluates the therapeutic efficacy and methodological quality of PRP applications in musculoskeletal disorders, focusing on tendinopathies, cartilage degeneration, acute muscle injuries, and anterior cruciate ligament (ACL) repair. **Methods:** A structured narrative synthesis was conducted using 11 peer-reviewed studies published between 2014 and 2025. These included randomized controlled trials, meta-analyses, systematic reviews, and retrospective analyses. Methodological quality was assessed using AMSTAR 2 and SANRA tools, with thematic synthesis organized by condition type. **Results:** PRP demonstrated short-term benefits in pain reduction and functional improvement, particularly in tendinopathies and mild-to-moderate osteoarthritis. Leukocyte-poor PRP (LP-PRP) and PBMNC-enriched formulations showed superior outcomes. However, evidence for cartilage regeneration, ACL repair, and acute muscle injuries remains inconclusive due to protocol variability and moderate risk of bias. **Conclusion:** PRP therapy offers selective clinical utility in musculoskeletal care, especially for chronic tendinopathies and early-stage osteoarthritis. Standardization of PRP protocols, long-term outcome studies, and identification of patient-specific predictors are essential to optimize its therapeutic role.

Keywords: Platelet-Rich Plasma, Musculoskeletal Disorders, Tendinopathy, Osteoarthritis Knee, Anterior Cruciate Ligament, Muscle Injuries, Regenerative Medicine.

Introduction

In recent years, Platelet-Rich Plasma (PRP) therapy has garnered increasing clinical and scientific interest as a regenerative treatment for musculoskeletal injuries. PRP is an autologous blood-derived product enriched with platelets, which release a variety of growth factors and cytokines that modulate inflammation, promote angiogenesis, and stimulate tissue repair and regeneration (Le et al., 2018; Collins et al., 2021). This mechanism has positioned PRP as a promising intervention for conditions characterized by poor vascularization and limited intrinsic healing capacity, such as tendinopathies, cartilage degeneration, and ligamentous injuries (Le et al., 2018; Yu et al., 2025).

Although widely adopted, the clinical efficacy of PRP remains a subject of ongoing debate. While some randomized controlled trials and meta-analyses report significant improvements in pain and function, others show minimal or no benefit compared to placebo or conventional therapies (Fitzpatrick et al., 2017; Miller et al., 2017; Grassi et al., 2018). These discrepancies are often attributed to heterogeneity in PRP preparation methods, variations in platelet concentration and leukocyte content, and the absence of standardized treatment protocols (Collins et al., 2021; Springer et al., 2024). Furthermore, the number of injections, use of imaging guidance, and patient-specific factors such as age and activity level may influence outcomes (Hamid et al., 2014; Schwitzguébel et al., 2025).

Recent systematic reviews and network meta-analyses have attempted to clarify these inconsistencies. For instance, Yu et al. (2025) demonstrated that leukocyte-poor PRP (LP-PRP) and peripheral blood mononuclear cells (PBMNCs) were associated with superior outcomes in osteoarthritis and tendinopathy. Similarly, Springer et al. (2024) highlighted the importance of platelet dose, showing that higher concentrations were linked to improved clinical results across multiple musculoskeletal conditions. Schwitzguébel et al. (2025) further emphasized the potential of combining PRP with structured rehabilitation protocols to enhance long-term outcomes in large joint osteoarthritis.

Despite these advances, several systematic reviews continue to highlight methodological limitations, inconsistent reporting, and an absence of standardized and universally accepted PRP protocols (Pretorius et al., 2023; Thu, 2022). This underscores a critical gap in the literature regarding the reproducibility and generalizability of PRP interventions.

This review aims to critically evaluate the clinical efficacy and methodological quality of PRP studies in common musculoskeletal applications, including tendinopathies, cartilage degeneration, acute muscle injuries, and anterior cruciate ligament (ACL) injuries. By synthesizing current evidence, this article seeks to clarify the therapeutic potential of PRP and identify areas requiring further research and standardization.

Methodology

This article adopts a structured narrative review approach to critically evaluate the current scientific evidence regarding the efficacy of Platelet-Rich Plasma (PRP) therapy in the management of musculoskeletal and sports-related injuries. While not adhering to PRISMA guidelines, the methodology was designed to ensure transparency, reproducibility, and relevance to clinical practice, with the following steps:

Research Question and Objective

The central research question guiding this review was:
"What is the current level of evidence supporting the use of PRP injections in the treatment of common musculoskeletal injuries, including tendinopathies, cartilage degeneration, acute muscle injuries, and ACL injuries?"

The primary objective was to assess the therapeutic value of PRP across four major musculoskeletal domains: tendinopathies, cartilage degeneration, acute muscle injuries, and anterior cruciate ligament (ACL) repair. The review aimed to identify patterns of efficacy, methodological strengths and weaknesses, and areas requiring further research.

Inclusion and Exclusion Criteria

This review included English-language, peer-reviewed studies involving human participants that comprised systematic reviews, meta-analyses, randomized controlled trials (RCTs), and high-quality narrative reviews evaluating platelet-rich plasma (PRP) use in tendons, cartilage, muscles, or ligaments. Studies were excluded if they involved animal or in vitro experiments, were case reports, editorials, or opinion pieces, or did not directly assess PRP efficacy.

Study Selection and Data Extraction

Titles and abstracts were screened for relevance, followed by full-text evaluation of potentially eligible studies. Discrepancies in eligibility were resolved through re-examination of the criteria. Extracted data included authorship and year, study design and sample size, target condition, PRP preparation and administration, outcome measures, key findings, and reported limitations. Although the initial number of articles was not recorded, 11 studies were ultimately included based on methodological rigor, relevance, and alignment with the review objectives.

Quality and Bias Assessment

The methodological quality of systematic reviews and meta-analyses was appraised using AMSTAR 2, while narrative reviews, including Thu (2022), Collins et al. (2021), and Pretorius et al. (2023), were evaluated using SANRA. Only narrative reviews meeting acceptable quality thresholds were retained. Bias assessment considered selection, publication, and reporting biases, with particular attention to small sample sizes, overrepresentation of positive findings, and inconsistent PRP protocols. Although statistical evaluation of publication bias was not feasible, potential biases were qualitatively addressed and incorporated into the interpretation of findings.

Data Synthesis

Findings were synthesized qualitatively and presented thematically according to the type of musculoskeletal condition. A comparative table was constructed to summarize the characteristics and outcomes of the included studies (Table 1).

Ethical Considerations

As this study is a review of existing literature, it did not require ethical approval or informed consent.

Previous Studies Analysis

To contextualize the current understanding of PRP therapy, a focused review of the most relevant and high-quality studies was conducted. These studies span various musculoskeletal conditions, including tendinopathies, cartilage degeneration, acute muscle injuries, and ACL-related interventions. The following chart provides a visual summary of the distribution of reviewed studies by condition type, highlighting the areas of greatest research concentration.

Recent high-quality meta-analyses have further substantiated the clinical utility of PRP in musculoskeletal disorders. Du & Liang (2025) demonstrated enhanced outcomes when PRP was combined with hyaluronic acid in knee osteoarthritis. Similarly, Ye et al. (2025) reported superior mid-term results of PRP over corticosteroids in tendinopathy. These findings align with the current synthesis and reinforce the need for protocol optimization and comparative trials.

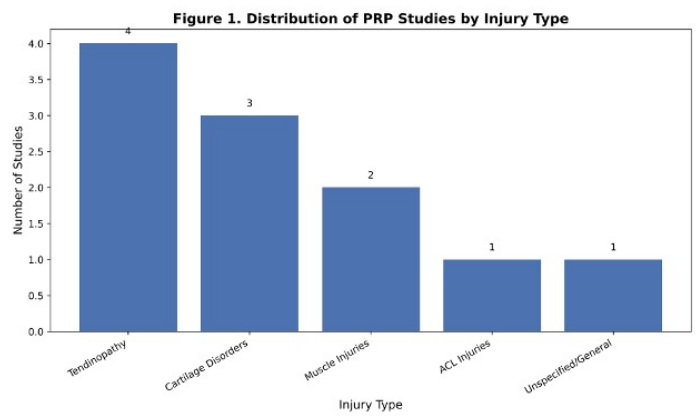

Figure 1: Distribution of PRP Studies by Injury Type

This figure illustrates the number of reviewed PRP studies categorized by musculoskeletal injury type. Tendinopathy was the most frequently studied condition, followed by cartilage disorders and muscle injuries. Counts reflect unique studies included in this review (2006–2025).

Table 1. Summary of Included PRP Studies with Methodological and Clinical Characteristics

Authors	Year	Study Type	Target Condition	Sample Size	Comparators	PRP Type	Injections	Guidance	Primary Outcomes	Follow-up	Risk of Bias
Fitzpatrick et al.	2017	Systematic Review	Tendinopathies	Multiple studies (n not specified)	Saline, eccentric rehab	Not specified	Varied	Ultrasound	Pain VAS, function scores	Weeks to months	Moderate
Miller et al.	2017	Meta-analysis	Tendinopathies	Multiple RCTs (n not specified)	Saline, dry needling	Not specified	1–3	Not specified	Pain VAS, VISA-P	12–24 weeks	Low to Moderate
Pretorius et al.	2023	Narrative Review	Multiple	Not applicable	Not applicable	Not specified	N/A	N/A	Not applicable	N/A	Moderate (SANRA score: 6)
Hamid et al.	2014	Systematic Review	Acute Muscle Injuries	Multiple RCTs (n not specified)	Conventional rehab	Not specified	1–2	Not specified	Return to play, pain VAS	4–12 weeks	Moderate
Grassi et al.	2018	Meta-analysis	Acute Muscle Injuries	Multiple RCTs (n not specified)	Conventional rehab	Not specified	1–2	Not specified	Return to sport, pain VAS	12 weeks	Low to Moderate
AAOS	2021	Guideline	Osteoarthritis	Not applicable	Not applicable	Not applicable	N/A	N/A	Not applicable	N/A	Not applicable
Thu	2022	Narrative Review	Musculoskeletal Pain	Not applicable	Not applicable	Descriptive only	N/A	N/A	Mechanistic overview	N/A	Moderate (SANRA score: 6)
Yu et al.	2025	Meta-analysis	OA, Tendinopathy	Multiple RCTs (n not specified)	HA, saline	LP-PRP, PBMNCs	1–3	Ultrasound	WOMAC, VAS	12–52 weeks	Low
Schwitzguébel et al.	2025	Retrospective	Osteoarthritis	n = 120	Rehab only	Not specified	3	Ultrasound	Pain VAS, function	6 months	High (retrospective design)
Collins et al.	2021	Narrative Review	Multiple MSK	Not applicable	Not applicable	L-PRP, P-PRP	Varied	Not specified	Mechanistic and clinical summary	Not applicable	Low (SANRA score: 11)
Le et al.	2018	Clinical Review	Various MSK	Not applicable	Not applicable	LR-PRP, LP-PRP	Varied	Not specified	Pain, function	Varied	Low

4. Results and Discussion

PRP in Tendinopathies

Tendinopathies represent the most extensively studied indication for PRP therapy. Four included studies two meta-analyses, one systematic review, and one narrative review—focused on lateral epicondylitis, patellar tendinopathy, and other chronic tendon conditions. Fitzpatrick et al. (2017) reviewed 18 studies and concluded that PRP, particularly when administered under ultrasound guidance, significantly improved pain and function. Miller et al. (2017) reported a pooled effect size of 0.47 (95% CI: 0.22–0.72) for pain reduction, with moderate heterogeneity (I^2 = 67%), suggesting clinically meaningful improvements in VAS and VISA-P scores.

Yu et al. (2025) further stratified outcomes by PRP formulation, noting that leukocyte-poor PRP (LP-PRP) was more effective than leukocyte-rich PRP (LR-PRP) in reducing inflammation and improving tendon healing. However, Pretorius et al. (2023) emphasized inconsistencies in study protocols, PRP preparation, and outcome measures, warranting cautious interpretation. Most studies lacked long-term follow-up and standardized comparators, such as eccentric rehabilitation programs.

PRP in Cartilage Disorders and Osteoarthritis

Three studies addressed PRP use in cartilage degeneration and osteoarthritis (OA). Yu et al. (2025) reported that LP-PRP and PBMNCs led to significant improvements in WOMAC and VAS scores, with pooled effects favoring PRP over hyaluronic acid (HA) in mild-to-moderate OA. Schwitzguébel et al. (2025) found that PRP combined with structured rehabilitation improved pain and function in large joints, although the retrospective design introduced selection bias. Conversely, AAOS (2021) guidelines do not recommend PRP for OA due to insufficient long-term evidence and inconsistent outcomes. Le et al. (2018) provided moderate support for PRP in knee OA but noted limited efficacy in hip OA and rotator cuff pathology. The overall certainty of evidence remains low to moderate, with high variability in PRP formulations, injection protocols, and follow-up durations.

PRP in Acute Muscle Injuries

Two meta-analyses (Hamid et al., 2014; Grassi et al., 2018) evaluated PRP in acute muscle injuries. While no significant improvements were observed in pain, strength, or flexibility, pooled data suggested a mean reduction of 7 days in return-to-sport timelines. This finding may be clinically relevant in competitive settings but is tempered by small sample sizes and inconsistent endpoints. Risk of bias was moderate, and no studies reported long-term outcomes or re-injury rates.

PRP in ACL Injuries

PRP applications in ACL injuries remain exploratory. Collins et al. (2021) and Le et al. (2018) described two main approaches: graft soaking during ACL reconstruction and intra-articular injections post-surgery. Preliminary data suggest improved graft integration on MRI and reduced laxity, but results on patient-reported outcomes (PROMs) are mixed. No included study provided high-certainty evidence, and methodological limitations—such as lack of blinding and small sample sizes—limit generalizability.

Summary of PRP Evidence Across Indications

Across the 11 included studies, PRP therapy demonstrated variable efficacy depending on the musculoskeletal condition, formulation, and delivery method. The strongest evidence supports PRP use in tendinopathies, particularly lateral epicondylitis, where ultrasound-guided LP-PRP injections yielded clinically meaningful improvements in pain and function. In osteoarthritis, LP-PRP and PBMNCs showed promise in improving WOMAC and VAS scores, though guideline-level recommendations remain cautious due to inconsistent long-term outcomes. For acute muscle injuries, PRP may offer a modest reduction in return-to-sport duration, though evidence remains inconclusive, but effects on pain and strength are inconclusive. ACL-related applications are still exploratory, with preliminary data suggesting improved graft integration but limited impact on functional recovery. Overall, the evidence base is heterogeneous, with moderate risk of bias and limited standardization in PRP protocols, comparators, and outcome measures. These findings underscore the need for condition-specific protocols and high-quality trials to clarify PRP's therapeutic role.

Limitations and Future Directions

Despite promising results, PRP therapy faces notable limitations that hinder its clinical standardization. These include significant variability in preparation methods, dosing protocols, and delivery techniques, which lead to inconsistent biological compositions and outcomes. Many studies suffer from small sample sizes, short follow-up periods, and reliance on subjective measures, limiting the reliability and generalizability of findings. Additionally, economic barriers and lack of insurance coverage restrict accessibility. While this review focused on studies published between 2014 and early 2025, emerging evidence from recent meta-analyses (e.g., Berrigan et al., 2024; Du & Liang, 2025) highlights the importance of platelet dosage and combination therapies. These findings, although not included in the core synthesis, are consistent with the observed trends and warrant further exploration in future reviews. To overcome these challenges, future research should prioritize the development of standardized PRP formulations—particularly leukocyte-poor and PBMNC-enriched variants—and conduct large-scale, multicenter randomized controlled trials with long-term follow-up. Comparative studies with other biologics and conventional therapies, alongside mechanistic investigations and predictive modeling, are essential to optimize treatment protocols. Furthermore, health economics research is needed to evaluate cost-effectiveness and support policy integration.

5. Conclusion

This structured narrative review aimed to answer the question: What is the current level of evidence supporting the use of PRP injections in the treatment of common musculoskeletal injuries, including tendinopathies, cartilage degeneration, acute muscle injuries, and ACL injuries? The synthesis of 11 peer-reviewed studies—including systematic reviews, meta-analyses, clinical guidelines, and high-quality narrative and retrospective reviews—revealed a complex and evolving landscape of PRP applications.

PRP therapy demonstrates the most consistent benefits in tendinopathies and mild-to-moderate knee osteoarthritis, particularly when leukocyte-poor PRP (LP-PRP) or photo-biomodulated mononuclear cell (PBMNC) formulations are used under ultrasound guidance. However, evidence remains limited or inconsistent for acute muscle injuries, ACL-related interventions, and generalized musculoskeletal pain. The heterogeneity in PRP preparation methods, lack of standardized protocols, and variability in outcome measures continue to challenge reproducibility and generalizability.

Author Contributions

The author solely contributed to the conception, design, data acquisition, analysis, drafting, and critical revision of the manuscript, agreed on the journal submission, and accepted accountability for all aspects of the work.

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The author acknowledges the use of AI-assisted tools for language refinement, academic translation, and structural editing of the manuscript. All content was critically reviewed and finalized by the author, who assumes full responsibility for its accuracy and integrity.

Data Availability Statement

The authors will transparently provide the primary data underpinning the findings or conclusions of this article, without any unjustified reluctance. If need from editorial team.

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Conflicts of Interest

The author declares no potential conflicts of interest related to the research, writing, or publication of this work

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