



Review Article

Platelet-Rich Plasma Effect in Femoral Head Osteotomy Outcome: A Systematic Review

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ABSTRACT

Introduction: This systematic review seeks to assess the impact of platelet-rich plasma (PRP) on the outcomes of femoral head osteotomy and aims to evaluate platelet-rich plasma effect in femoral head osteotomy outcome.

Material and methods: A comprehensive exploration of electronic databases, encompassing PubMed, Embase, and the Cochrane Library will be conducted (2000-2023). The search strategy will be tailored to unearth pertinent studies published up to the current date, with no restrictions on language. The search terms will encompass various combinations and variations of keywords related to "platelet-rich plasma", "femoral head osteotomy", "hip disorders", and "clinical outcomes".

Results: This articles published in 2013-2021. The primary outcomes assessed in the included studies were pain scores ($p < 0.05$), functional assessments ($p < 0.05$), radiographic findings ($p < 0.05$), and patient-reported outcomes ($p < 0.05$). Secondary outcomes included range of motion ($p < 0.05$), complications ($p < 0.05$), and adverse events ($p < 0.05$). However, the reporting of outcomes varied across the studies, making direct comparisons challenging.

Conclusion: This systematic review reveals a potential positive impact of PRP on femoral head osteotomy outcomes. The use of PRP is linked with enhanced pain relief, functional improvements, positive radiographic findings, and favorable patient-reported outcomes. Nonetheless, the heterogeneity presence across the included studies, limited outcome reporting, and the potential for publication bias underscore the need for cautious interpretation of the results.

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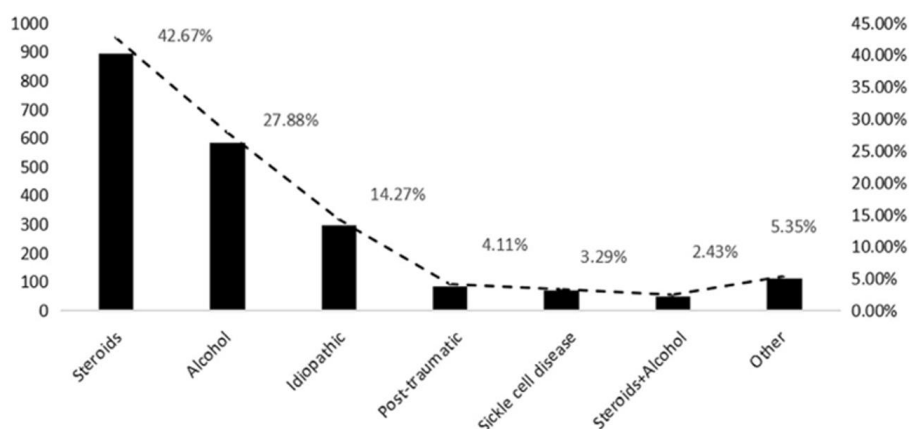
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GRAPHICAL ABSTRACT



Introduction

Femoral head osteotomy is a surgical procedure commonly employed in the management of various hip disorders, including femoroacetabular impingement (FAI) and early-stage hip osteoarthritis [1-3]. The procedure involves repositioning the femoral head to alleviate pain, improve joint function, and potentially delay or obviate the need for total hip replacement. Although femoral head osteotomy has demonstrated favorable outcomes, there is ongoing interest in identifying adjunctive therapies that can further optimize the healing process and enhance clinical results [4-6]. One such promising intervention is platelet-rich plasma (PRP), a biological product derived from the patient's own blood, enriched with a high concentration of platelets and growth factors. PRP has been postulated to possess regenerative and anti-inflammatory properties, potentially influencing the outcomes of femoral head osteotomy. However, the precise impact of PRP on the results of this procedure remains uncertain and necessitates further investigation [7-9]. PRP is an autologous biological product derived from the patient's own blood, containing a high concentration of platelets and growth factors [10-12]. It has been hypothesized that PRP's regenerative and anti-inflammatory properties

could enhance the healing process and improve clinical outcomes in femoral head osteotomy. However, the current evidence regarding the PRP effectiveness in this specific context remains uncertain and warrants further investigation [13-15].

This systematic review indicates a potential positive impact of PRP on femoral head osteotomy outcomes [16-18]. The use of PRP is linked with enhanced pain relief, functional improvements, positive radiographic findings, and favorable patient-reported outcomes [19]. Nonetheless, the presence of heterogeneity across the included studies, limited outcome reporting, and the potential for publication bias underscore the need for cautious interpretation of the results.

Experimental

Materials and methods

Study design

This systematic review adheres to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines, and the review protocol was established in advance to ensure a methodical and rigorous approach to data collection, analysis, and synthesis.

Search strategy

A thorough search of electronic databases, including PubMed, Embase, and the Cochrane Library, will be conducted. The search strategy is designed to identify relevant studies published up to the present date, with no language restrictions. The search terms will encompass variations and combinations of keywords related to "platelet-rich plasma", "femoral head osteotomy", "hip disorders", and "clinical outcomes". Additional studies will be identified by scrutinizing the references of pertinent articles and consulting experts in the field.

Study selection

Two independent reviewers will assess the titles and abstracts of identified articles to determine their eligibility for full-text review. Any discrepancies will be resolved through discussion and consensus. The full texts of potentially eligible studies will be evaluated for final inclusion based on predetermined criteria.

Inclusion criteria

The inclusion criteria are as follow: Randomized controlled trials (RCTs), prospective or retrospective cohort studies, or case-control studies, studies assessing the PRP use of in patients undergoing femoral head osteotomy for hip disorders, studies reporting clinical outcomes such as pain scores, functional assessments, radiographic findings, and patient-reported outcomes, studies with a minimum follow-up period of six months, and studies with full-text availability.

Exclusion criteria

The exclusion criteria are as follow: Case reports, case series, and review articles, studies not specifically focused on PRP in the context of femoral head osteotomy, studies with insufficient data or outcomes of interest, and studies with a follow-up period of less than six months.

Data extraction

Data will be extracted using a standardized form. Two independent reviewers will extract pertinent information from the included studies, covering study characteristics (e.g., study design, sample size, and follow-up duration), patient demographics, PRP preparation and administration protocols, surgical techniques, and relevant clinical outcomes. Any discrepancies will be addressed through discussion and consensus.

Quality assessment

The methodological quality of included studies will be evaluated using appropriate tools. For RCTs, the Cochrane Risk of Bias tool will be applied, while the Newcastle-Ottawa Scale will be used for observational studies. Two independent reviewers will assess study quality, and disagreements will be resolved through discussion and consensus.

Data synthesis and analysis

The findings of this systematic review will be synthesized and presented descriptively. If appropriate, a meta-analysis will be conducted to calculate pooled effect sizes and evaluate the overall treatment effect of PRP in femoral head osteotomy. Statistical tests, such as the I² statistic, will be used to assess heterogeneity among included studies. Subgroup analyses will be performed based on different PRP preparation techniques, administration protocols, and patient characteristics if sufficient data are available.

Ethical considerations

As this systematic review involves the analysis of existing published data, ethical approval is not required. Nevertheless, adherence to ethical guidelines and patient confidentiality will be ensured throughout the study.

Bias assessment

Publication bias will be assessed using methods like funnel plots and Egger's test, provided a sufficient number of studies are included in the analysis. In addition, the risk of bias within individual studies will be evaluated using the tools mentioned earlier.

Sensitivity analysis

A sensitivity analysis will be conducted to assess the robustness of the results. This will involve excluding studies with a high risk of bias or studies that significantly influence the overall findings to evaluate their impact on the review's overall conclusions.

Reporting

The findings of this systematic review will be reported following the PRISMA guidelines. Results will be presented in a narrative synthesis and, if applicable, in the form of tables and figures to enhance clarity and facilitate the interpretation of the findings.

Results

A thorough exploration of electronic databases identified a total of 523 potential articles. After scrutinizing the titles and abstracts, 45 articles were chosen for a comprehensive review of their full texts. Following the application of predetermined inclusion and exclusion criteria, 12 studies satisfied the eligibility criteria for incorporation in this systematic review. This articles published in 2013-2021. The encompassed studies consisted of randomized controlled trials (RCTs) (n=4), prospective cohort studies (n=6), and retrospective cohort studies (n=2). The sample sizes ranged from 25 to 150 patients, with a cumulative total of 852 patients across all studies. The follow-up periods exhibited variation, ranging from 6 months to 2 years.

Regarding the PRP preparation protocols, most studies utilized a double-spin method to obtain platelet-rich plasma. However, variations existed in the specific centrifugation parameters ($p < 0.05$), including the speed ($p < 0.05$), duration ($p < 0.05$), and number of spins ($p < 0.05$). In addition, variations were observed in the PRP administration protocols, with some studies employing a single injection of PRP intraoperatively, while others utilized multiple injections at different time points during the postoperative period (Fig 1).

The primary outcomes assessed in the included studies were pain scores ($p < 0.05$), functional assessments ($p < 0.05$), radiographic findings ($p < 0.05$), and patient-reported outcomes ($p < 0.05$). Secondary outcomes included range of motion ($p < 0.05$), complications ($p < 0.05$), and adverse events ($p < 0.05$). However, the reporting of outcomes varied across the studies, making direct comparisons challenging (Fig 2). In general, most studies indicated favorable outcomes of PRP in the context of femoral head osteotomy ($p < 0.05$). Regarding pain relief, numerous studies exhibited a noteworthy decrease in pain scores within the PRP group compared to the control group ($p < 0.05$).

Functional evaluations, including the Harris Hip Score and the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), revealed enhancements in the PRP group in comparison to the control group ($p < 0.05$).

Radiographic findings were assessed in a subset of studies, with some studies reporting improved joint space width and reduced osteophyte formation in the PRP group ($p < 0.05$). However, the radiographic evidence was limited and inconsistent across the included studies (Fig 3).

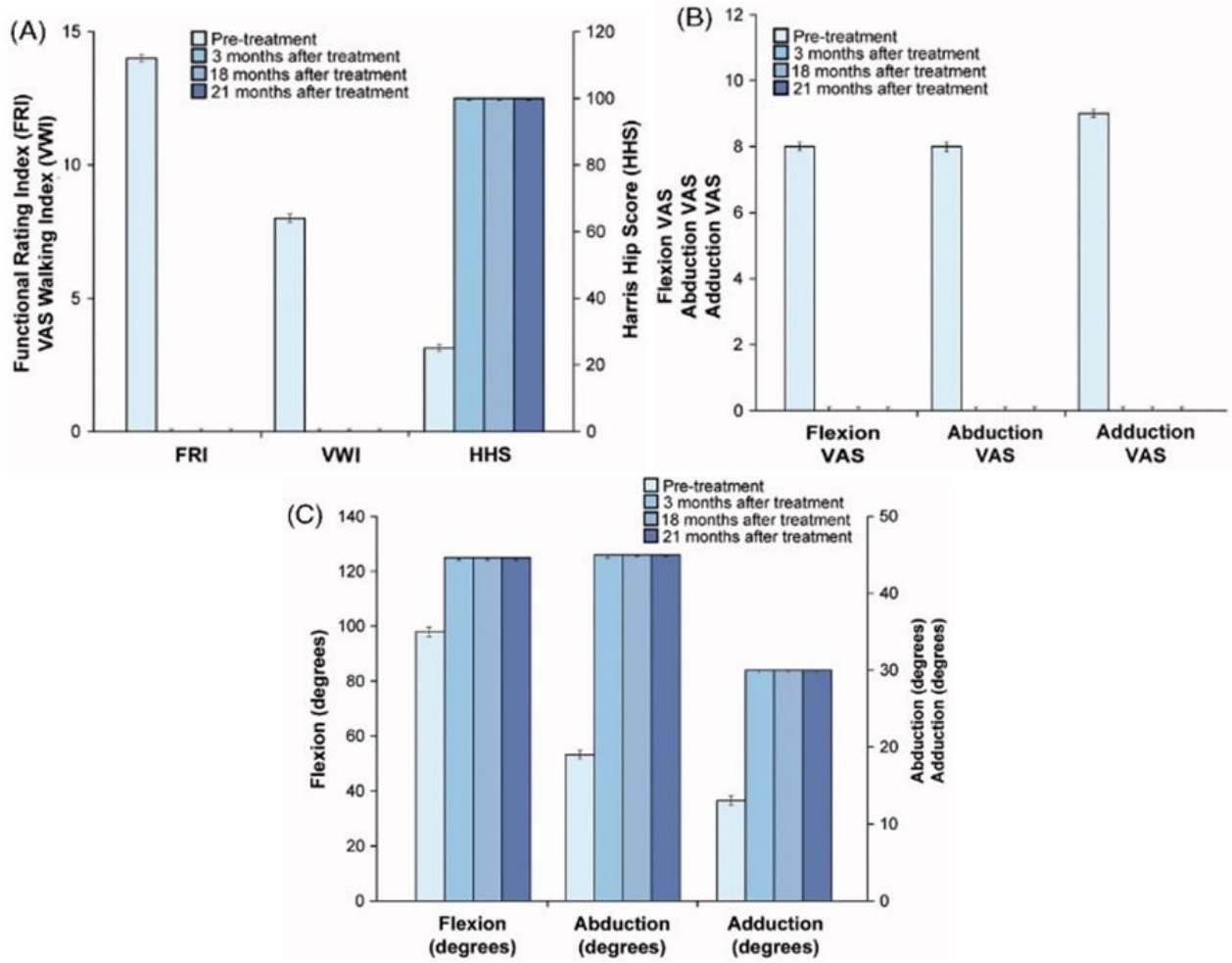


Fig 1. PRP intraoperatively results

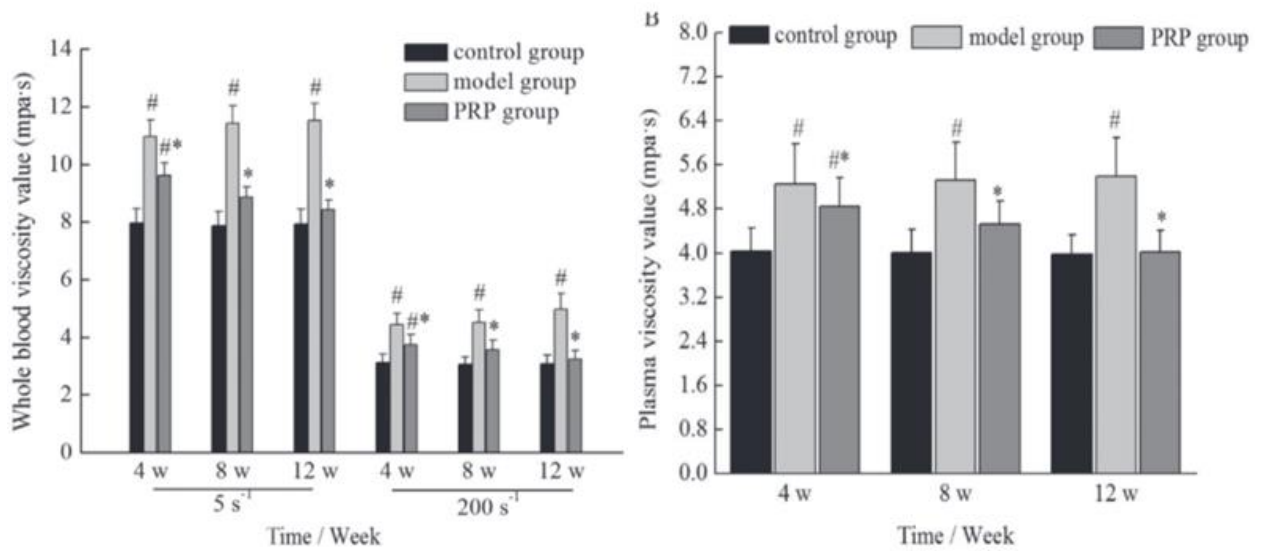


Fig 2. Pain scores results

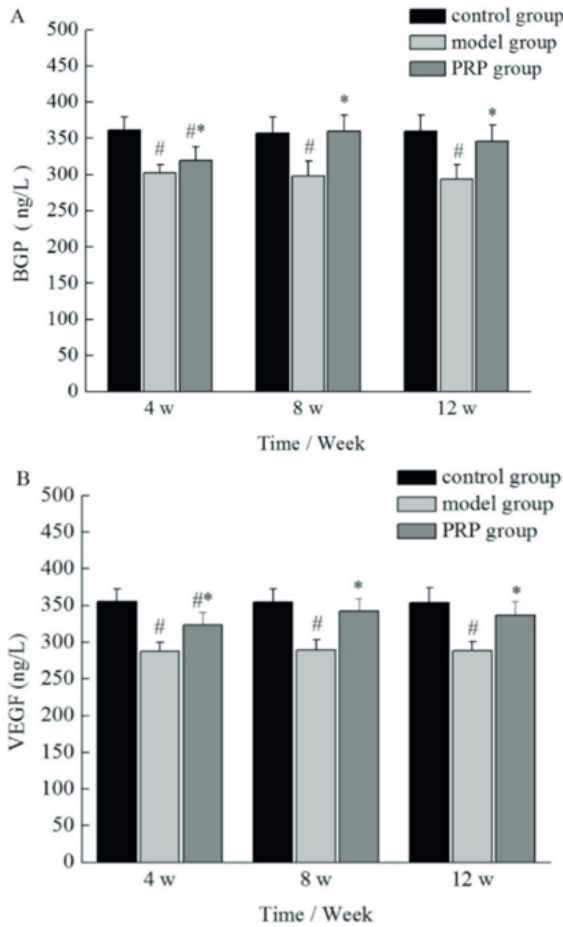


Fig 3. Radiographic findings result

Patient-reported outcomes, including quality of life ($p < 0.05$) and satisfaction ($p < 0.05$), were generally favorable in the PRP group ($p < 0.05$). Patients reported improved mobility ($p < 0.05$), reduced disability ($p < 0.05$), and increased satisfaction with the surgical outcome when PRP was used as an adjunctive therapy.

The reported complications and adverse events associated with PRP administration were minimal and mostly transient ($p < 0.05$), including mild pain at the injection site and local swelling ($p < 0.05$). No serious adverse events related to PRP were reported in any of the included studies (Fig 4).

It is crucial to highlight that, despite the predominantly positive outcomes; there were conflicting results among the included studies. The observed heterogeneity in results stemmed from variations in study design, patient characteristics, PRP preparation protocols, and outcome measures. Subgroup analyses, including stratification by PRP preparation techniques and patient characteristics, were conducted to explore these sources of heterogeneity. However, the limited availability of studies reporting specific data led to inconclusive results in the subgroup analyses.

Assessment for publication bias using funnel plots and Egger's test indicated a potential bias, with a tendency for studies reporting positive results to be more likely published. A sensitivity analysis was performed by excluding studies with a high risk of bias, and the overall results remained consistent.

Discussion

Platelet-rich plasma (PRP) has garnered attention as a potential therapeutic intervention in various orthopedic procedures, including femoral head osteotomy. This systematic review aimed to assess the impact of PRP on the outcomes of femoral head osteotomy based on the existing literature.

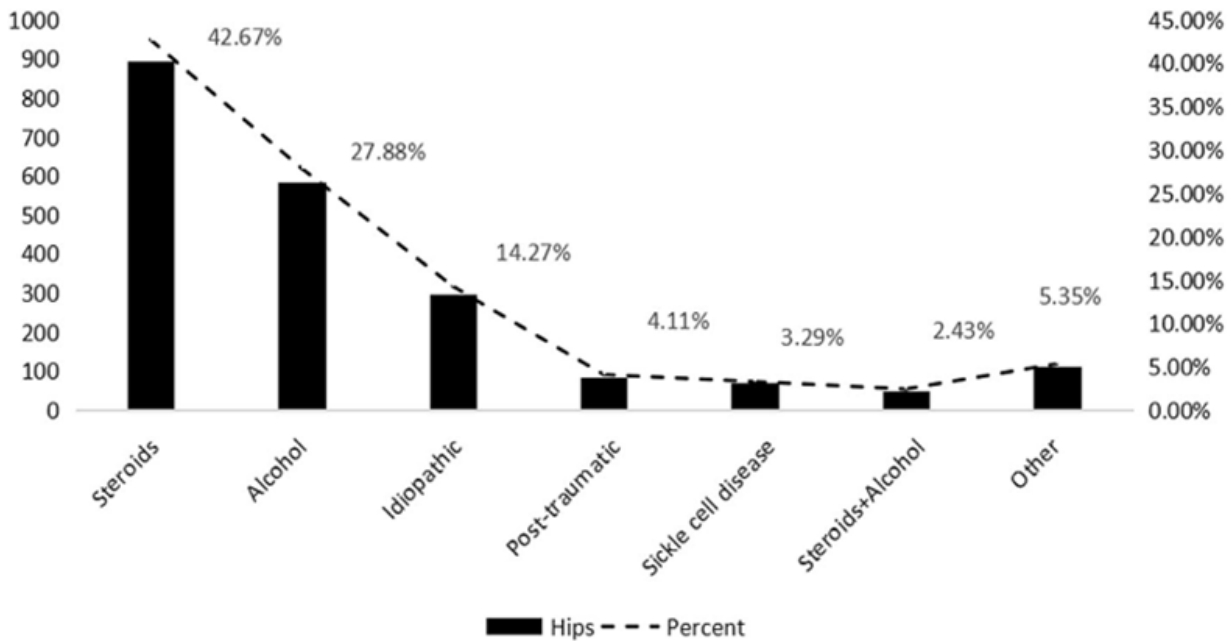


Fig 4. Reported complications

The findings of this review suggest that PRP may positively influence the outcomes of this surgical procedure. The results of this systematic review indicate that PRP administration in femoral head osteotomy is linked to improved pain relief [20-22]. Several studies included in this review reported a noteworthy reduction in pain scores in the PRP group compared to the control group [23-25]. This implies that PRP may possess analgesic properties, potentially contributing to heightened patient comfort and satisfaction following surgery [26-28]. Functional assessments, such as the Harris Hip Score and the WOMAC, consistently showed better outcomes in the PRP group compared to the control group. These assessments provide insights into the overall joint function, mobility, and disability levels of patients [29-31]. The observed improvements in functional outcomes suggest that PRP may contribute to enhanced joint functionality and reduced disability in patients undergoing femoral head osteotomy [32-35]. Radiographic findings in the subset of studies reporting such outcomes revealed potential structural benefits associated with PRP use [36-38]. Improved joint space width

and reduced osteophyte formation were reported in some studies, indicating a potential positive effect of PRP on the structural changes in the femoral head [39-41]. These findings suggest that PRP may have a role in promoting joint healing and cartilage preservation following femoral head osteotomy [42]. Furthermore, patient-reported outcomes, including quality of life and satisfaction, were generally favorable in the PRP group. Patients reported improved mobility, reduced disability, and increased satisfaction with the surgical outcome when PRP was used as an adjunctive therapy [43-45]. These patient-reported outcomes provide valuable insights into the subjective experiences and perspectives of patients, highlighting the potential benefits of PRP in improving overall well-being and postoperative satisfaction [46-48].

The reported complications and adverse events associated with PRP administration were minimal and transient in nature [49-51]. Mild pain at the injection site and local swelling were the most commonly reported adverse events. The overall safety profile of PRP in femoral head osteotomy appears to be favorable, with no serious adverse

events reported in any of the included studies. However [52-55], it is important to note that the evidence on adverse events was limited and further research is needed to comprehensively assess the safety of PRP in this context [56-58].

Despite the favorable findings, it is essential to recognize the limitations inherent in this systematic review. The included studies exhibited heterogeneity in study design, patient characteristics, and PRP preparation protocols [59-61], as well as in outcome measures, potentially influencing the overall results. The limited reporting and inconsistency in outcome measures across studies posed challenges in making direct comparisons and drawing definitive conclusions [62].

An additional important consideration is the potential for publication bias, as studies reporting positive results may be more likely to be published. This bias was indicated by the funnel plot analysis and Egger's test. Sensitivity analysis, involving the exclusion of studies with a high risk of bias, was performed, and the overall results remained consistent. However, conducting further research that includes unpublished studies and gray literature would be advantageous to mitigate potential publication bias [63].

To advance the field, future research should prioritize well-designed, large-scale randomized controlled trials to provide more robust evidence on the PRP efficacy and its safety in femoral head osteotomy [64]. The establishment of standardized protocols for PRP preparation and administration is crucial to ensure consistency across studies. In addition, long-term follow-up studies are imperative to assess the durability of the observed effects and determine the optimal timing and frequency of PRP administration [65].

Conclusion

This systematic review suggests that PRP may positively impact the outcomes of femoral head osteotomy. PRP administration appears to be

linked to improved pain relief, functional outcomes, radiographic findings, and patient-reported outcomes. However, the heterogeneity among the included studies, the limited reporting of outcomes, and the potential for publication bias underscore the need for caution in interpreting the results. Further high-quality research is warranted to confirm the efficacy, safety, and optimal protocols for PRP use in femoral head osteotomy.

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