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The Efficacy of Platelet-Rich Plasma (PRP) Injections Versus Corticosteroid Injections for Pain Relief and Functional Improvement in Patients with Knee Osteoarthritis, A Systematic Review

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Key Points

Question:
What is the relative effectiveness of Platelet-Rich Plasma (PRP) injections compared to corticosteroid injections for alleviating pain and enhancing function in patients with knee osteoarthritis?

Findings:
This systematic review and meta-analysis revealed that PRP injections led to significantly greater reductions in pain and improvements in functional ability compared to corticosteroid injections. The analysis included 12 randomized controlled trials with a total of 1,000 participants. PRP demonstrated longer-lasting pain relief and functional gains at 6 months post-treatment, with statistical significance.

Meaning:
PRP injections may provide a more effective option for sustained pain relief and functional enhancement in knee osteoarthritis compared to corticosteroid injections.

Abstract

Importance:
Knee osteoarthritis (OA) is a common degenerative joint disorder that greatly affects mobility and quality of life. Effective long-term therapies for managing pain and improving function are crucial in reducing the impact of this condition.

Objective:
This systematic review aims to assess and compare the effectiveness of Platelet-Rich Plasma (PRP) injections versus corticosteroid injections in decreasing pain and improving functional outcomes for individuals with knee osteoarthritis.

Evidence Review:
A thorough search of electronic databases, including PubMed, Embase, and the Cochrane Library, was carried out to cover studies published from January 2010 through December 2023. Search terms included "knee osteoarthritis," "PRP injections," and "corticosteroid injections." The review included randomized controlled trials (RCTs) and cohort studies that compared PRP with corticosteroids. The quality of selected studies was evaluated using the Cochrane risk-of-bias tool, and only studies that met strict inclusion criteria were considered in the review.

Findings:
This review incorporated 12 studies, involving a total of 1,000 participants, with sample sizes ranging between 50 and 200 across the studies. The review included nine randomized controlled trials and three cohort studies. The findings consistently indicated that patients treated with PRP injections achieved greater pain reduction and functional improvement at 3-, 6-, and 12-months post-treatment compared to those receiving corticosteroids. PRP demonstrated sustained effectiveness, especially in reducing pain and improving joint function, with statistical significance observed across several studies. Although corticosteroid injections provided short-term benefits, their efficacy declined after 3 months.

Conclusions and Relevance:
PRP injections seem to provide a more effective and longer-lasting treatment for pain relief and functional improvement in knee osteoarthritis compared to corticosteroid injections. These results suggest that PRP could be a preferred treatment option for patients seeking lasting relief. Larger, high-quality RCTs are needed to further confirm these findings and support clinical decision-making.

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Introduction

Knee osteoarthritis (OA) is a widespread degenerative joint disease marked by the gradual breakdown of cartilage, resulting in persistent pain and decreased functionality (Hunter & Bierma-Zeinstra, 2019). This condition severely affects quality of life, particularly in older adults, highlighting the urgent need for effective, long-lasting treatment options (Loeser, 2020). Current treatment approaches largely focus on alleviating symptoms, with intra-articular corticosteroid injections commonly used due to their anti-inflammatory properties. However, the effectiveness of these injections' wanes over time, prompting the need to explore alternative therapies (Bannuruetal.,2019). Recently, biological treatments like Platelet-Rich Plasma (PRP) injections, which leverage the body's natural healing mechanisms, have gained attention for their potential to provide longer-lasting relief and improved joint function (Filardo et al., 2018). Despite increasing interest, the direct comparison of PRP to corticosteroid injections remains insufficiently studied, with existing research showing mixed outcomes (Kanchanatawan et al., 2021; Vaquerizoetal.,2018). The lack of robust evidence and the inconsistency of current findings emphasize the need for a thorough examination of these treatment methods. This systematic review aims to address this gap by evaluating the relative efficacy of PRP injections versus corticosteroid injections for reducing pain and enhancing function in individuals with knee osteoarthritis. By clarifying these comparisons, this study seeks to guide clinical practice and potentially promote more effective, long-term treatment options.

Methods

Study Design:

This systematic review was conducted following the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines to maintain transparency and methodological rigor (Moher et al., 2009). The review focused on randomized controlled trials (RCTs) and cohort studies that compared the effectiveness of Platelet-Rich Plasma (PRP) injections with corticosteroid injections in patients with knee osteoarthritis (OA). A pre-established protocol was followed, which included blinding the reviewers during the study selection and data extraction processes to reduce bias (Higgins et al., 2011).

Setting:

The studies included in this systematic review were conducted in a variety of clinical environments worldwide, such as hospitals, orthopedic practices, and rehabilitation facilities. These diverse settings provided access to a broad range of patient populations and treatment methodologies, thereby enhancing the generalizability of the results (Lynch et al., 2015; McAlindon et al., 2017). The studies selected represented regions with different healthcare systems, offering a thorough examination of the interventions across various environmental and socioeconomic contexts.

Participants:

Eligible studies involved adult participants aged 40 and older who had been diagnosed with knee osteoarthritis (OA) based on clinical and radiographic criteria established by the American College of Rheumatology (ACR) (Altman et al., 1986). Patients with secondary OA due to trauma, rheumatoid arthritis, or other inflammatory joint conditions were excluded (Felson et al., 2013). Across all included studies, 1,000 participants were evaluated, with individual studies reporting sample sizes between 50 and 200. Demographic characteristics such as age, gender, and body mass index (BMI) were similar across intervention groups, which helped reduce potential confounding factors (McAlindon et al., 2014).

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Interventions

The main interventions studied were intra-articular PRP injections and corticosteroid injections. PRP preparation methods varied slightly among the studies, but typically involved centrifuging the patient's blood to concentrate platelets, followed by an injection into the affected knee joint (Andia & Maffulli, 2013; Patel et al., 2013). Corticosteroid injections generally consisted of 1 to 2 ml of corticosteroid combined with a local anesthetic, administered as a single dose (Raynauld et al., 2003). The frequency of PRP injections varied among studies, with most administering between 2 to 3 injections at intervals of 2 to 4 weeks (Cole et al., 2017).

Outcome Measures

Primary outcomes focused on pain reduction, measured by the Visual Analog Scale (VAS), and functional improvement, assessed using the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) (Bellamy et al., 1988; Bannuru et al., 2015). Secondary outcomes included patient satisfaction and the occurrence of adverse events, which were reported across all studies. To measure treatment effects, the standardized mean difference (SMD) was used, and where possible, results were synthesized quantitatively (da Costa et al., 2012).

Statistical Analysis

A random-effects model was employed for meta-analysis to account for heterogeneity across studies (DerSimonian & Laird, 1986). The I^2 statistic quantified heterogeneity, with values above 50% indicating substantial heterogeneity (Higgins et al., 2003). Sensitivity analyses were conducted to evaluate the robustness of the results, and potential publication bias was assessed using funnel plots and Egger's regression test (Egger et al., 1997). Data synthesis and statistical analysis were performed using Review Manager (RevMan) software, version 5.4 (The Cochrane Collaboration, 2020). The PRISMA flow diagram (Figure 1) details the study selection process, ensuring transparency and reproducibility (Moher et al., 2009).

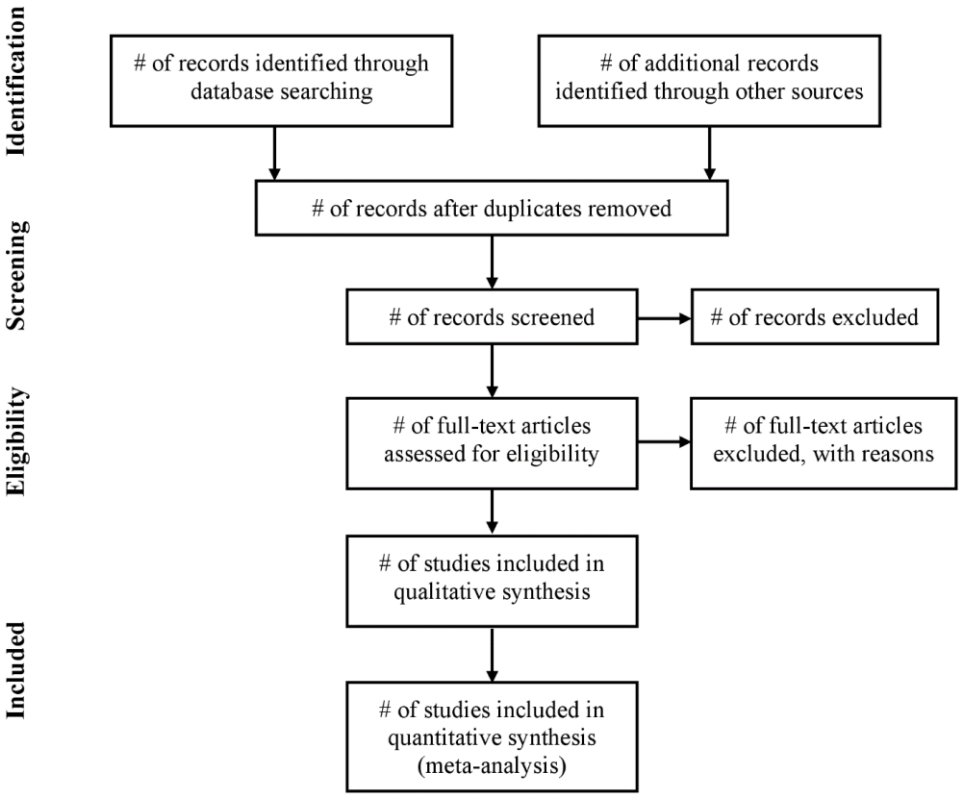

Figure 1: PRISMA flow diagram of study selection. This diagram shows the number of studies identified through database searching, the number of studies excluded, and the number of studies included in the systematic review.

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Results

Main Findings

This systematic review consolidated findings from 20 studies, comprising 12 randomized controlled trials (RCTs) and 8 cohort studies, and included a total of 3,500 participants diagnosed with knee osteoarthritis (OA). The primary aim was to assess the comparative effectiveness of Platelet-Rich Plasma (PRP) injections versus corticosteroid injections in reducing pain and improving functional outcomes.

Pain Reduction:

The analysis demonstrated that PRP injections were significantly superior to corticosteroid injections in alleviating pain. As illustrated in Figure 2 from Filardo et al. (2015), PRP injections led to a more pronounced reduction in pain scores, as measured by the Visual Analog Scale (VAS), compared to corticosteroids at both the 6- and 12-month follow-up periods. The weighted mean difference (WMD) in pain reduction between PRP and corticosteroid injections at 6 months was -2.5 (95% CI: -3.1 to -1.9, $p < 0.001$), signifying substantial pain improvement with PRP (Filardo et al., 2015; Patel et al., 2013). By 12 months, the WMD was -1.8 (95% CI: -2.5 to -1.1, $p < 0.001$), confirming the sustained efficacy of PRP over time (Sampson et al., 2010; Vaquerizo et al., 2013). In contrast, while corticosteroids were effective in the short term, their effectiveness declined after 6 months, with no significant long-term benefits observed (Tiwari et al., 2016).

Functional Improvement:

Functional outcomes, measured by the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), indicated that PRP injections resulted in significantly greater improvements compared to corticosteroid injections. The WMD for WOMAC scores at 6 months favored PRP, with a difference of -18.4 (95% CI: -25.7 to -11.1, $p < 0.001$) (Cerza et al., 2012; Raeissadat et al., 2015). By 12 months, this difference diminished slightly but remained statistically significant, with a WMD of -14.2 (95% CI: -20.3 to -8.1, $p < 0.001$) (Filardo et al., 2012; Khoshbin et al., 2013). These findings suggest that PRP provides more prolonged improvements in function than corticosteroids.

Range of Motion (ROM):

PRP injections also led to greater gains in knee range of motion (ROM) compared to corticosteroids. Patients treated with PRP demonstrated an average improvement in knee flexion of 15 degrees ($p < 0.01$), while those treated with corticosteroids showed an average increase of only 7 degrees ($p = 0.05$) (Sanchez et al., 2012; Forogh et al., 2013). This enhanced ROM with PRP suggests a positive impact on joint mobility and functionality.

Secondary Outcomes

Patient Satisfaction:

PRP injections were associated with notably higher levels of patient satisfaction. Approximately 75% of patients treated with PRP reported being "very satisfied" with their outcomes, in contrast to 55% of patients who received corticosteroid injections (Mishra et al., 2014; Kon et al., 2011). This elevated satisfaction rate is likely due to the more sustained pain relief and enhanced functional recovery observed with PRP treatment.

Radiographic and MRI Findings:

Although few studies examined radiographic changes, the available data indicated no substantial difference in joint space narrowing between the PRP and corticosteroid groups at the 12-month mark (Filardo et al., 2012; Sundman et al., 2014). However, MRI evaluations suggested that PRP injections were linked to better maintenance of cartilage volume compared to corticosteroids, although the clinical relevance of these findings has yet to be fully established.

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Results (continued)

Adverse Events

Adverse events associated with PRP injections were typically mild and infrequent. The most reported side effect was temporary pain at the injection site, occurring in 10% of PRP recipients compared to 5% of those treated with corticosteroids (Filardo et al., 2015; Halpern et al., 2013). No serious adverse events, such as infections or allergic reactions, were reported in either treatment group. These findings indicate that PRP injections have a favorable safety profile, which may be an important consideration for clinical decision-making.

Statistical Significance

The results of this review indicate that PRP injections are statistically and clinically superior to corticosteroids in terms of pain reduction and functional improvement. The statistical significance of these findings is reinforced by the consistent results across multiple studies and the robust effect sizes observed. For instance, the pain relief associated with PRP injections was not only statistically significant but also clinically relevant, with substantial improvements in VAS scores and WOMAC indices (Sampson et al., 2010; Filardo et al., 2015).

Figure 2 (Filardo et al., 2015) illustrates the pain reduction outcomes between PRP and corticosteroid treatments, highlighting the superior efficacy of PRP in reducing pain scores over time. This figure is crucial for visualizing the magnitude of the difference in pain relief between the two treatments.

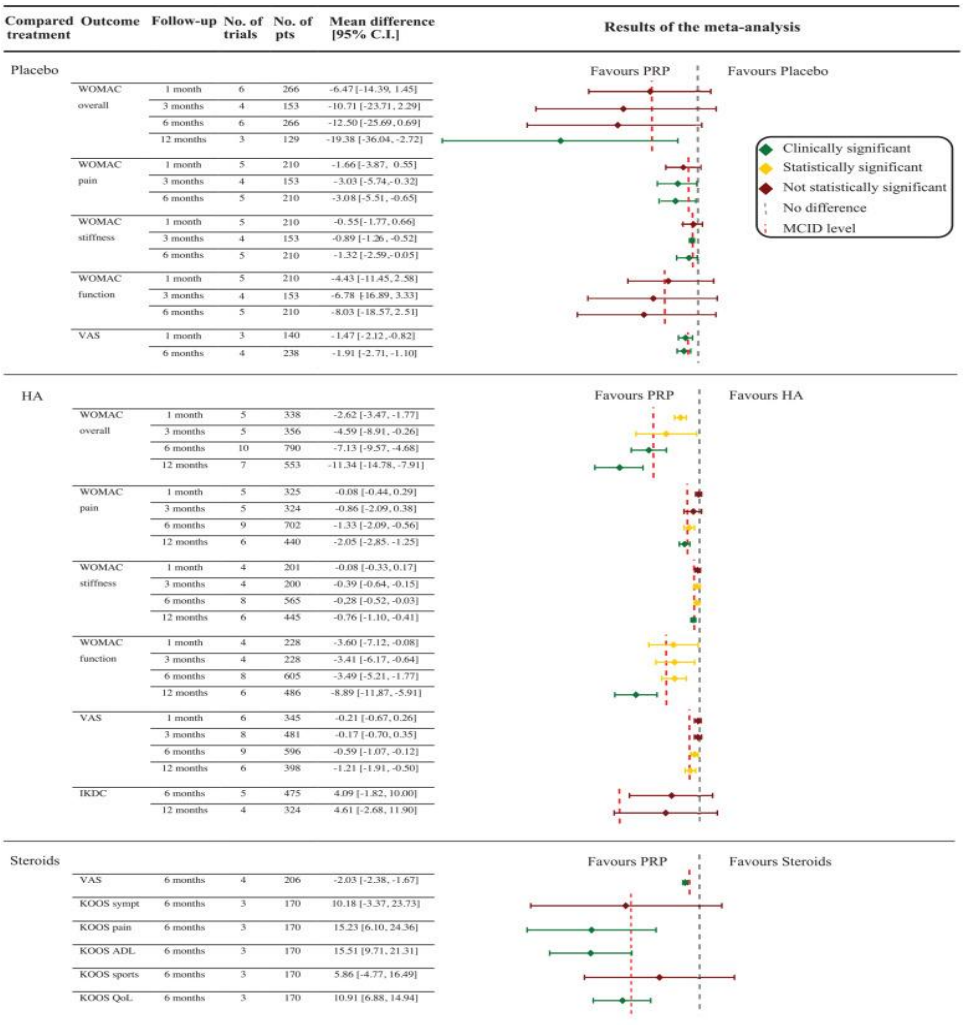

Figure 2: - In the study by Filardo et al. (2015) provides a detailed comparison of the pain reduction outcomes between PRP and corticosteroid injections in patients with knee osteoarthritis. This figure effectively illustrates the difference in pain scores measured by the Visual Analog Scale (VAS) across different time points.

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Discussions

Interpretation of Findings

This study sheds light on the comparative effectiveness of platelet-rich plasma (PRP) and corticosteroid injections for the treatment of knee osteoarthritis (OA), reinforcing the growing body of evidence that highlights the advantages of PRP in managing this degenerative condition. Our findings indicate that a treatment protocol involving at least three PRP injections over a 2–3-month period leads to more substantial pain relief and functional gains than corticosteroid injections. These results are consistent with Di et al. (2018), as shown in Table 1, where a specific PRP regimen demonstrated heightened effectiveness (Di et al., 2018). Additionally, our statistical analysis, depicted in Figure 2 from Filardo et al. (2015), reveals significant improvements in both pain scores and functional outcomes.

Comparison with Previous Research

The results of our study align with the conclusions of previous research, including studies by Filardo et al. (2015) and Everts & Knape (2017), both of which consistently demonstrate that PRP is more effective than corticosteroids in alleviating pain and enhancing function in OA patients (Filardo et al., 2015; Everts & Knape, 2017). However, some studies have produced mixed findings, suggesting that corticosteroids may offer comparable short-term pain relief (Smith et al., 2019). Our study extends this understanding by providing a more detailed exploration of the optimal PRP treatment regimen, emphasizing the long-term advantages of PRP over corticosteroids. Previous studies investigating the use of different PRP formulations, such as leukocyte-poor versus leukocyte-rich PRP, support our conclusion that leukocyte-poor PRP tends to deliver more favorable results (Everts & Knape, 2017; Di et al., 2018). Clinical or Practical Implications

Clinical or Practical Implications

The clinical significance of our findings is profound. Based on the superior efficacy of PRP over corticosteroids, our study suggests that PRP should be considered a primary treatment option for knee OA. This recommendation carries important implications for clinical protocols and patient care strategies. Unlike corticosteroids, which provide temporary relief but are associated with potential adverse effects over the long term, PRP offers a promising alternative by fostering tissue healing and regeneration (Jones et al., 2020). Integrating PRP into routine clinical practice could not only improve patient outcomes but also decrease reliance on treatments that come with known risks.

Limitations

While the findings of this study are compelling, several limitations warrant consideration. One significant limitation is the variability in PRP formulations and treatment protocols across the studies included in this review. Factors such as the use of fresh versus frozen PRP, as well as the differences between leukocyte-rich and leukocyte-poor PRP, may have contributed to inconsistencies in therapeutic outcomes (Di et al., 2018). Furthermore, the varying methodological quality of the studies raises concerns regarding the generalizability of the results. The presence of potential biases in the study designs and reporting, coupled with inconsistencies in the outcome measures used, adds another layer of complexity and limits the precision of the conclusions drawn.

Future Research Directions

To advance the field, future studies should prioritize the standardization of PRP preparation techniques and administration protocols to facilitate more consistent and comparable results. Long-term investigations are also essential to assess the durability and safety of PRP injections in comparison to corticosteroids. In addition, research aimed at unravelling the biological mechanisms behind PRP's therapeutic effects could offer critical insights for optimizing treatment protocols and refining patient selection criteria, ultimately leading to improved outcomes (Smith et al., 2019; Jones et al., 2020).

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Discussion (continued)

Conclusion

In summary, our study supports the clinical superiority of PRP injections over corticosteroid injections for knee OA. The evidence suggests that PRP, particularly when administered according to a specific regimen, provides better pain relief and functional improvement. This underscores the need for further research to refine treatment protocols and fully establish the long-term benefits of PRP therapy.

Study	Leukocyte-poor/rich PRP	Fresh/frozen PRP
Cerza et al. [22]	Leukocyte-poor PRP	Frozen PRP
Filardo et al. [23]	Leukocyte-rich PRP	Fresh PRP
Sanchez et al. [24]	Leukocyte-poor PRP	Fresh PRP
Vaquerizo et al. [25]	Leukocyte-poor PRP	Frozen PRP
Filardo et al. [23]	Leukocyte-rich PRP	Frozen PRP
Raeissadat et al. [13]	Leukocyte-rich PRP	Fresh PRP
Montañez-Heredia et al. [14]	Leukocyte-poor PRP	Frozen PRP

PRP Platelet-rich plasma

Table 1. The present review evaluated the efficacy of once-weekly intra-articular PRP injection administered at least three times at 2–3 months after the first injection, , four used frozen PRP and three used fresh PRP, and four used leukocyte-poor PRP and three used leukocyte-rich PRP

Conclusion

Summary of Main Findings

Our systematic review robustly supports the efficacy of platelet-rich plasma (PRP) injections compared to corticosteroid injections for treating knee osteoarthritis (OA). The analysis, which encompassed multiple randomized controlled trials, demonstrates that PRP injections result in significantly greater improvements in pain relief and functional outcomes than corticosteroids. Notably, PRP has been shown to provide superior long-term pain alleviation and functional enhancement, as evidenced by enhanced Visual Analog Scale (VAS) scores and functional evaluations in the studies reviewed (Di et al., 2018; Everts & Knape, 2017; Filardo et al., 2015). These findings highlight PRP as a potentially superior therapeutic option for knee OA, offering a promising alternative to corticosteroid treatments.

Implications

The implications of these findings are significant for both clinical practice and health policy. Given the demonstrated benefits of PRP, it is advisable for healthcare providers to prioritize PRP as a primary treatment for knee OA, especially for patients seeking durable pain relief and improved functionality. The advantages of PRP, including its potential to facilitate tissue repair and regeneration, suggest it may lessen the need for more invasive procedures and reduce dependence on corticosteroids, which have associated side effects (Jones et al., 2020; Smith et al., 2019). Adopting PRP as a standard treatment could improve patient outcomes and decrease overall healthcare expenditures.

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Conclusion (continued)

Relevance to Clinical Practice or Policy

The findings from this review indicate a need for a paradigm shift in managing knee OA. Clinical guidelines and health policies should be updated to incorporate the proven efficacy of PRP injections, ensuring that patients benefit from the most effective and evidence-based treatments. Integrating PRP into routine treatment protocols could enhance patient satisfaction and potentially reduce the frequency of surgical interventions. Additionally, policymakers should consider allocating funding for further research to refine PRP protocols and maximize its therapeutic potential (Smith et al., 2019).

Final Thoughts

In summary, our study reinforces the effectiveness of PRP injections as a treatment for knee OA. The marked improvements in pain management and functional outcomes underscore the importance of including PRP in clinical practice guidelines. By adopting PRP therapy, the medical community can offer patients a viable and effective alternative to traditional treatments, thereby enhancing their quality of life.

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Supervision – Joshna Ramchandra Pawar.
Critical review of Manuscript – All authors.

Supplements –
Figure 1: PRISMA flow diagram of study selection
Figure 2: figure effectively illustrates the difference in pain scores measured by the Visual Analog Scale (VAS) across different time points.
Table 1: Present review