# Comparison of Intra Articular Injection of Platelet Rich Plasma with Hyaluronic Acid in Osteoarthritic Knee.

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## ABSTRACT:

**Objective:** To compare the efficacy and safety of intra articular injection of Platelet Rich Plasma (PRP) and Hyaluronic Acid (HA) in patients with osteoarthritic knee.

**Methods:** This observational comparative study was carried out in the Anesthesia Department of the Abbassi Shaheed Hospital (ASH) from December, 2022 to May, 2023. There were 42 patients with confirmed diagnosis of Knee Joint Osteoarthritis with eligibility criteria were enrolled. Twenty-one study participants were randomized to receive intra articular injection of PRP (Group A), while the remaining 21 study participants received HA (Group B). Socio demographics data, anthropometric measurement, disease duration data was collected. Importantly, the pain score using Visual Analogue Scale (VAS) and WOMAC a validated tool was used to clinically assess the patients at baseline and first- and third-month follow-up. SPSS version 21 was used to analyze data.

**Results:** There was no significant difference in mean age, gender, ethnicity, disease duration and disease grading among patients randomized to Group A or B. Moreover, no significant difference was identified between mean pain score and mean WOMAC score at baseline. Importantly, significant difference was observed in mean pain score and mean WOMAC score at first- and third-month follow-up. Importantly, significant decrease in mean pain score on VAS and mean WOMAC score was observed among patient randomized to receive Platelet Rich Plasma as compared to Hyaluronic Acid.

**Conclusion:** Patients with knee osteoarthritis treated with intra-articular injection of Platelet Rich Plasma showed improved clinical outcomes as compared to Hyaluronic Acid. This is evident from the significant decrease in mean pain score as well as mean WOMAC score at follow-ups on first and third month.

**Keywords:** Knee osteoarthritis, Platelet Rich Plasma, Hyaluronic Acid, Visual Analogue scale, WOMAC, pain.

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## Introduction:

For both male or female patients, joint arthritis of the knee has tremendous impact on functionality and is one of ten causes of influence on functioning.[1] Over 20% of those 45 years of age or older suffer from osteoarthritis of the knee joint, a chronic, degenerative condition.[2] Inflammation of the joint lining provokes gnawing of articular cartilage and involvement of the underlying bone in the pathological process. This disease can affect any joint; however, the destruction of cartilage is the basic change characteristic of this condition. Osteoarthritis ranks second in causing loss of working capacity due to health problems alongside low back pain.[3] Moreover, during the current demographic wave of aging populations, the demand for knee arthroplasty is projected to increase by more than six times by 2030, resulting in substantial socioeconomic costs related to pain management and rehabilitation.[4] Therefore, reducing pain, enhancing function and mobility, preventing or correcting deformity, and decreasing the disease's progression can be considered the goals of osteoarthritis treatment.[5]

Visco supplementation is used in conjunction with medications like analgesics, corticosteroids, glucosamine, chondroitin, sulfate, and non-steroidal anti-inflammatory drugs (NSAIDs) to treat pain, manage related symptoms, and slow the progression of the disease.[6] Additionally, intra-articular injection is thought to be an effective way to administer medications for arthritis[7,] Hyaluronic acid (HA) or platelet-rich plasma (PRP) are two successful therapy methods.[8]

However, the findings of the numerous clinical trials evaluating the clinical efficacy of platelet-rich plasma (PRP) and hyaluronic acid (HA) varied. The effectiveness of long-term injections of hyaluronic acid (HA) and platelet-rich plasma (PRP) in patients diagnosed with knee OA with pain was actually the subject of a single-center RCT conducted at the Shahid Modarres Hospital between April 2012 and February 2014. The PRP injection was found to be more effective than the HA injection.[9] The meta-analysis found that PRP injection was more effective than HA and normal saline in treating mild to moderate cases of OA; however, the number of side effects was higher in the PRP-injected group of patients than in the HA or placebo group (8.4% v 3.8%; P = 0.002). Additionally, it has been reported tha

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PRP is more suitable than HA and placebo for treating osteoarthritis in the knee because the WOMAC scores were significantly better at 3-6 months (28.5 and 43.4, respectively; P =.0008) and at 6-12 months (22.8 and 38.1, respectively; P =.0062). According to a different study.[9] PRP does not precede HA in middle-aged individuals with moderate OA.

For the treatment of osteoarthritic knee, intra-articular injections of hyaluronic acid and platelet-rich plasma are frequently given; however, no investigation comparing the two treatment modalities' safety and effectiveness has been carried out in Pakistan. Moreover, the clinical trials conducted have compared only the clinical efficacy and not safety. Moreover, there has been limited use of validated tool of efficacy i.e. McMaster Universities Arthritis Index (WOMAC). In order to examine the safety and effectiveness of hyaluronic acid and platelet-rich plasma for the treatment of individuals with a verified diagnosis of osteoarthritic knee, this randomized control trial was created. In order to improve patient outcomes in terms of better management and fewer adverse events, the study's findings will give clinicians evidence to choose the appropriate treatment option.

## Methodology:

This observational comparative study was conducted in the outpatient pain management clinic of the Department of Anaesthesia at Abbassi Shaheed Hospital, Karachi, from December 2022 to May 2023. Abbassi Shaheed Hospital was selected as the study site because the lead investigator was stationed there, ensuring feasibility in conducting the research and recruiting patients with osteoarthritic knees. Furthermore, the pain management clinic of the Department of Anaesthesia at Abbassi Shaheed Hospital maintains a sufficient patient flow to enrol the required number of participants. Following approval of the study summary, the trial was scheduled to last for six months.

Patients aged 18 to 65 years of both genders with mild to moderate knee osteoarthritis, defined radiographically as Grade 1 (presence of osteophytes without joint space narrowing) or Grade 2 (moderate reduction in joint space) according to the Kellen-Lawrence classification, chronic knee pain or swelling for at least four months, and no clinical improvement after physical therapy will be eligible for inclusion. Patients will be excluded if they present with severe knee osteoarthritis, pregnancy, systemic disorders such as diabetes or rheumatoid arthritis, autoimmune conditions, prior surgery on the affected joint, major axial deviations (varus or valgus >5°), hematological disorders including coagulopathies, severe cardiovascular disease, infections, immunosuppression, or current use of non-steroidal anti-inflammatory drugs, anticoagulants, antithrombotic or antiplatelet agents. Additional exclusion criteria include hemoglobin levels below 11 mg/dL, platelet counts under 150,000/mm³, known hypersensitivity to study medications or their components, and unwillingness to provide informed consent.

## Data Collection Procedure:

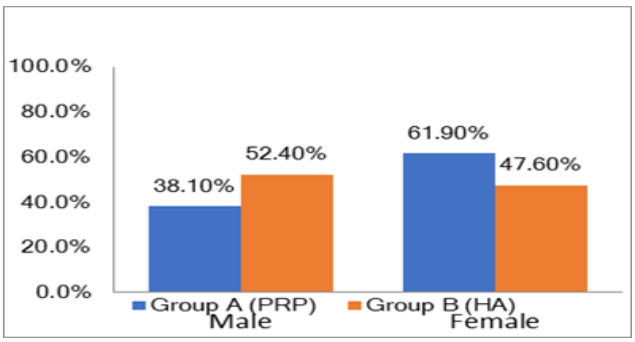
Following informed permission and using a non-probability consecutive sampling technique, the study participants recommended for the treatment of osteoarthritic knee after meeting the inclusion and exclusion criteria will be listed in this trial. Following enrollment, each participant will be randomly assigned by lottery to one of two trial arms: intra-articular injection of either hyaluronic acid (Group B) or platelet-rich plasma (Group A). The results of a double-blind, randomized, controlled clinical trial comparing clinical efficacy were carried out in Iran by Mehdi Tavassoli et al.[10] The following data from the study was used to calculate the sample size for intra-articular injections of hyaluronic acid and platelet-rich plasma for osteoarthritic knees. According to the study's findings, patients treated with intra-articular injections of platelet-rich plasma (PRP) demonstrated a mean difference in WOMAC scores at the end of follow-up of 4.39 ± 3.57, while those receiving hyaluronic acid (HA) showed a mean difference of 1.11 ± 3.89. Using these values, the required sample size was estimated with the OpenEpi sample size calculator, applying a 95% confidence interval, 90% statistical power, and a 1:1 allocation ratio between treatment arms. The calculation yielded a total of 42 participants, with 21 individuals assigned to each group (PRP or HA). This sample size was considered adequate to detect clinically meaningful differences between the two interventions. For current study 21 participants will receive intra articular injection of platelet rich plasma (Group A), while the remaining 21 study participants will receive Hyaluronic acid (Group B). Hyaluronic acid is a viscous solution consisting of a high molecular weight (500,000–730,000 Da) fraction of purified natural sodium hyaluronate in buffered physiological sodium chloride, having a PH of 6.8-7.5.

**Data analysis plan:** Data will be collected using a pre-designed proforma and analyzed with SPSS version 20 for Windows. To ensure accuracy, the researcher will cross-check the entered data at least twice against the database. An independent t-test will be applied to compare demographic characteristics (e.g., age, disease duration) and anthropometric measurements (weight, height, BMI) between patients randomized to the platelet-rich plasma (PRP) and hyaluronic acid (HA) treatment arms. Chi-square test statistics will be used to compare categorical variables such as gender, ethnicity, and marital status between the treatment groups. The mean VAS and WOMAC scores will be compared at baseline, one-month follow-up, and three-month follow-up using independent t-tests. In addition, changes in VAS and WOMAC scores from baseline to one month and baseline to three months will be computed and compared between the two treatment arms. Finally, adverse events reported in each group will also be analyzed. For all inferential statistics, a p-value < 0.05 will be considered statistically significant.

## Results:

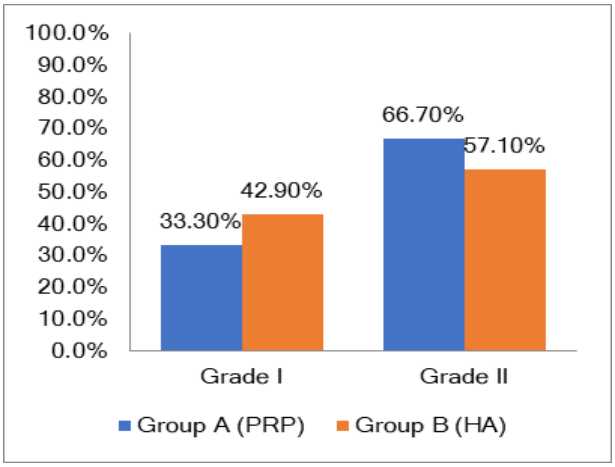
The comparison of mean age and age categories among patients with OA knee randomly allocated to PRP or HA at baseline is shown in graph 1. No significant difference in mean age in years was noticed between Group A and B (55.10 vs. 59.24; p-value = 0.307). Moreover, no significant difference was found in age categories between the two groups as p-value was 0.734.

**Graph 1: Comparison of Gender among patients with OA knee randomly allocated to PRP or HA at Baseline**



The comparison of anthropometric measurements among patients with OA knee randomly allocated to PRP or HA at baseline. There was no significant difference in mean weight measured in Kg between Group A and B (77.52 vs. 84.90; p-value = 0.067). Moreover, no significant difference was found in mean height in meters between Group A and B (1.61 vs. 1.62; p-value = 0.546). Finally, significant difference was also not found in mean BMI measured in kg/ $m^2$ between Group A and B (30.23 vs. 32.49; p-value = 0.214).

**Graph 2: Comparison of Disease Grading among patients with OA knee randomly allocated to PRP or HA at Baseline.**




The comparison of mean pain score among patients with OA knee randomly allocated to PRP or HA at first month follow-up. Significant difference in mean pain score between Group A and B was identified as (5.81 vs. 6.67; p-value = 0.001). Thus, mean pain score was significantly higher among patients allocated to group B at first month follow-up.

**Table No1: Comparison of Mean Pain Score among patients with OA knee randomly allocated to PRP or HA at First month & 3-month follow-up**

| Pain Score | Group A (PRP) Mean ± SD (n = 21) | Group B (HA) Mean ± SD (n = 21) | p-value |
|---|---|---|---|
| Pain Score (First month follow-up) | 5.81 ±0.60 | 6.67 ±0.58 | 0.001 |
| Pain Score (Third month follow-up) | 3.10 ±0.70 | 4.81 ±0.87 | 0.001 |

The comparison of mean WOMAC score among patients with OA knee randomly allocated to PRP or HA at first month follow-up. Significant difference in mean WOMAC score between Group A and B was identified as (47.33 vs. 51.19; p-value = 0.001). Thus mean WOMAC score was significantly higher among patients allocated to group B at first month follow-up.

**Table No 2: Comparison of Mean WOMAC Score among patients with OA knee randomly allocated to PRP or HA at First month & 3-month follow-up.**

| WOMAC Score | Group A (PRP) Mean ± SD | Group B (HA) Mean ± SD | p-value |
|---|---|---|---|
| WOMAC Score (First month follow-up) | 47.33 ± 5.16 | 51.19 ± 5.17 | 0.001 |
| WOMAC Score (Third month follow-up) | 31.33 ± 4.54 | 38.14 ± 3.41 | 0.001 |

The comparison of mean difference of pain score between baseline and first month among patients with OA knee randomly allocated to PRP or HA. Significant difference in mean decrease in pain score was observed between Group A and B was identified as (2.57 vs. 1.18; p-value = 0.001). Thus, mean decrease in pain score was significantly higher among patients allocated to group A.

**Table No 3: Comparison of Mean Difference of Pain Score between Baseline and First month & three month among patients with OA knee randomly allocated to PRP or HA.**

| Pain Score | Group A (PRP) Mean ± SD | Group B (HA) Mean ± SD | p-value |
|---|---|---|---|
| Mean Difference of Pain Score between Baseline and First month | 2.57 ± 0.75 | 1.18 ± 0.54 | 0.001 |
| Mean Difference of Pain Score between First month and Third month | 2.71 ± 0.56 | 1.86 ± 0.73 | 0.001 |

The comparison of mean difference of WOMAC score between first month and third month among patients with OA knee randomly allocated to PRP or HA. Significant difference in mean decrease in WOMAC score was observed between Group A and B was identified as (16.00 vs. 13.05; p-value = 0.001). Thus, mean decrease in WOMAC score was significantly higher among patients allocated to group A.

**Table No 4: Comparison of Mean Difference of WOMAC Score between First month and Third month among patients with OA knee randomly allocated to PRP or HA.**

| WOMAC Score | Group A (PRP) Mean ± SD (n = 21) | Group B (HA) Mean ± SD (n = 21) | p-value |
|---|---|---|---|
| Mean Difference of WOMAC Score between First month and Third month | 16.00 ± 3.33 | 13.05 ± 3.20 | 0.001 |
| Pain Score | Group A (PRP) Mean ± SD (n = 21) | Group B (HA) Mean ± SD (n = 21) | P-value |
| Mean Difference of Pain Score between Baseline and Third month | 5.29 ± 0.845 | 3.62 ± 0.921 | 0.001 |

**Table No 5: Comparison of Mean Difference of WOMAC Score between Baseline and Third month among patients with OA knee randomly allocated to PRP or HA**

| WOMAC Score | Group A (PRP) Mean ± SD (n = 21) | Group B (HA) Mean ± SD (n = 21) | p-value |
|---|---|---|---|
| Mean Difference of WOMAC Score between Baseline and Third month | 27.19 ± 3.19 | 21.86 ± 4.00 | 0.001 |

On a multiple response the adverse events were frequently more reported with HA as compared to PRP. The adverse events among patients given PRP were arthralgia (19.04%), injection site pain (4.8%), joint stiffness (4.8%), joint swelling (9.52%), musculoskeletal discomfort (4.8%) and GI disturbance as 4.8%). While the adverse events among patients given HA were arthralgia (28.57%), injection site pain (9.52%), joint stiffness (14.29%), joint swelling (19.04%), musculoskeletal discomfort (14.29%) and GI disturbance as 14.29%).

## Discussion:

Knee joint Osteoarthritis (OA) significantly impacts the physical performance and is amongst ten leading causes of disability around the globe.[11]Different modalities are available but two treatment modalities Platelet Rich Plasma and Hyaluronic Acid being more commonly used as intra-articular injections among these patients. The goal of the current randomized controlled study (RCT) was to assess the efficacy of intra-articular knee osteoarthritis injections of platelet-rich plasma (PRP) and hyaluronic acid (HA). The mean age, age groups, ethnicity, marital status, anthropometric data, disease duration, and disease groups did not differ statistically significantly, according to the current study's findings. Furthermore, there were no statistically significant differences between the baseline mean "Western Ontario and McMaster Universities Osteoarthritis" Index score and the mean pain score. However, the findings indicate that at the first and third-month follow-ups, there was a statistically significant difference in the mean pain and Western Ontario and McMaster Universities Osteoarthritis Index scores.

Importantly, significant decrease in mean pain score on VAS and mean WOMAC score was observed among patients who receive PRP as compared to HA.The results of the study can be connected to the evidence that is currently accessible in the literature.[12] A meta-analysis reported PRP injection more efficacious as compared to HA and normal saline in mild-to-moderate OA. The clinical trial conducted by Meheux et al.[13] highlighted that PRP was a better modality for the treatment of knee OA than HA or placebo, with mean post-treatment WOMAC scores for PRP were significantly better than for HA at 3 to 6 months and at 6 to 12 months.[14,15] However, it had been reported that that PRP is not superior to HA in middle-aged patients with moderate OA and not recommended as the first-line treatment option.[16] It is revealed that HA injections may be more helpful in lowering pain in mild OA of the knee for up to six months; nevertheless, the cost-effectiveness of HA injections remains a major problem. According to the study, current research suggests that PRP injections are beneficial for reducing pain, enhancing knee function, and improving quality of life especially for younger patients and those with moderate osteoarthritis. Less than 50% of patients demonstrated clinically significant improvement, despite the experts' conclusion in a review that PRP therapy had reported pain remission and function improvement. PRP is better than HA, and combining the two could be advantageous.

Recently, it has been reported that PRP acceptance had increased as one of the most efficacious treatments for mild to moderate OA, thereby suggesting it more clinically efficacious with low complication incidence.[17,18] It has been also reported recently that PRP has been shown to be typically safe as did not report major adverse outcomes among patients.[19,20]

A prospective RCT patients with knee OA were randomized to HA Corticosteroids or PRP and outcome was assessed with WOMAC and VAS score at baseline, 3, 6, 9 and 12 months.[17] The results of the study showed that each group's WOMAC and VAS scores had significantly improved. Following joint injection, PRP patients showed significantly lower scores at 6, 9, and 12 months after therapy, according to the first trial. As a result, intra-articular injection of platelet-rich plasma represents a legitimate therapeutic alternative, and its clinical effectiveness surpasses that of corticosteroids and hyaluronic acid.[21,22]

Only the PRP arm maintained the significant improvement in the WOMAC score, which rose by 21% at 12 months, according to an RCT.[9] According to a meta-analysis, PRP injections were superior to HA in lowering knee OA patients' pain at 6 and 12 months of follow-up as determined by WOMAC.[14] Before infiltration and at 3, 6, and 12 months, participants in prospective research that randomly assigned them to two study groups—the PRP group and the HA group—were assessed using the WOMAC score and visual pain scale.

## Conclusion:

The current RCT highlighted patients with knee osteoarthritis receiving PRP exhibited improved clinical outcomes as compared to HA. This is evident from the significant decrease in the mean pain score as well as mean WOMAC score during follow-ups on first and third month.

## References:


1. Ratan R, Basak M, Pal D, Dwivedi M, Haq RU. Females with Knee Osteoarthritis have Greater Pain and Reduced Physical Function but Similar Radiological Grading at Presentation: A Cross-sectional Observational Study. Indian J Orthop. 2025 Apr 15;59(4):549-557. doi: 10.1007/s43465-025-01365-x. PMID: 40276792; PMCID: PMC12014990.
2. Hsu H, Siwiec RM. Knee Osteoarthritis. 2023 Jun 26. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2023 Jan-. PMID: 29939661.
3. Alyousef YS, Johnston V, Mellor R, Plinsinga ML, Zerguine H, et al. The effect of lower limb osteoarthritis on work-related outcomes: a systematic review and meta-analysis. Disabil Rehabil. 2024 Aug;46(17):3792-3801. doi: 10.1080/09638288.2023.2259304. Epub 2023 Sep 22. PMID: 37740531.
4. Stubnya BG, Schulz M, Váncsa S, Szilágyi GS, Szatmári A, et al. Global Trends in Joint Arthroplasty: A Systematic Review and Future Projections. J Clin Med. 2025 Nov 19;14(22):8214. doi: 10.3390/jcm14228214. PMID: 41303249; PMCID: PMC12653837.
5. Farinelli L, Riccio M, Gigante A, De Francesco F. Pain Management Strategies in Osteoarthritis. Biomedicines. 2024 Apr 4;12(4):805. doi: 10.3390/

biomedicines12040805. PMID: 38672160; PMCID: PMC11048725.
6. Vitor Alfredo de Santana Silva, Katarine Gabriely Aurista do Nascimento, Priscila Gubert, Maria G. Carneiro-da-Cunha, Kátia Alves Ribeiro, et al. Impact of Symptomatic Slow-Acting Drugs on Inflammatory Pathways in Osteoarthritis: Therapeutic Advances and Future Challenges. ACS Pharmacol. Transl. Sci. 12 December 2025; 8 (12): 4214-4236. doi:10.1021/acsptsci.5c00521
7. Si-Hyeong Park S, Li B, Kim C. Efficacy of intra-articular injections for the treatment of osteoarthritis: A narrative review. Osteoarthr Cartil Open. 2025 Mar 5;7 (2):100596. doi: 10.1016/j.ocarto.2025.100596. PMID: 40144957; PMCID: PMC11938051.
8. Pamuk Ç. Comparison of Intra-articular Hyaluronic Acid and Platelet-Rich Plasma Injection in Knee Osteoarthritis: Do the Results Differ in Geriatric Patients? A Retrospective Observational Study. Ann Geriatr Med Res. 2022 Dec;26(4):340-346. doi: 10.4235/agmr.22.0090. Epub 2022 Dec 15. PMID: 36518061; PMCID: PMC9830060.
9. Li YF, Xing HH, Wei CK, Chen YT, Sun YQ, et al. Platelet-Rich Plasma Is More Effective Than Hyaluronic Acid Injections for Osteoarthritis of the Knee: A Meta -analysis Based on Randomized, Double-Blinded, Controlled Clinical Trials. Arthroscopy. 2025 Dec;41 (12):5304-5318. doi: 10.1016/j.arthro.2025.06.033. Epub 2025 Jul 16. PMID: 40681006.
10. Tavassoli M, Janmohammadi N, Hosseini A, Khafri S, Esmaeilnejad-Ganji SM. Single- and double-dose of platelet-rich plasma versus hyaluronic acid for treatment of knee osteoarthritis: A randomized controlled trial. World J Orthop. 2019 Sep 18;10(9):310-326. doi: 10.5312/wjo.v10.i9.310. PMID: 31572668; PMCID: PMC6766465.
11. Elmajee M, Mersal M, Zehra B, Ben Nafa W, Elsayed A, et al. Knee Osteoarthritis: Current Insights Into Pathophysiology and Non-surgical Management Options. Cureus. 2025 Oct 24;17(10):e95302. doi: 10.7759/cureus.95302. PMID: 41287699; PMCID: PMC12640556.
12. Glinkowski WM, Gut G, Śladowski D. Platelet-Rich Plasma for Knee Osteoarthritis: A Comprehensive Narrative Review of the Mechanisms, Preparation Protocols, and Clinical Evidence. J Clin Med. 2025 Jun 5;14 (11):3983. doi: 10.3390/jcm14113983. PMID: 40507744; PMCID: PMC12156035.
13. Meheux CJ, McCulloch PC, Lintner DM, Varner KE, Harris JD. Efficacy of Intra-articular Platelet-Rich Plasma Injections in Knee Osteoarthritis: A Systematic Review. Arthroscopy. 2016 Mar;32(3):495-505. doi: 10.1016/j.arthro.2015.08.005. Epub 2015 Oct 1. PMID: 26432430.
14. Zhuang W, Li T, Li Y, Zhang Y, Gao J, et al. The varying clinical effectiveness of single, three and five intraarticular injections of platelet-rich plasma in knee osteoarthritis. J Orthop Surg Res. 2024 May 8;19 (1):284. doi: 10.1186/s13018-024-04736-6. PMID: 38720362; PMCID: PMC11077828.
15. Bensa A, Previtali D, Sangiorgio A, Boffa A, Salerno M, et al. PRP Injections for the Treatment of Knee Osteoarthritis: The Improvement Is Clinically Significant and Influenced by Platelet Concentration: A Meta-analysis of Randomized Controlled Trials. Am J Sports Med. 2025 Mar;53(3):745-754. doi: 10.1177/03635465241246524. Epub 2025 Jan 3. PMID: 39751394; PMCID: PMC11874499.
16. Li M, Huang Z, Wang S, Di Z, Zhang J, Liu H. Intra-articular injections of platelet-rich plasma vs. hyaluronic acid in patients with knee osteoarthritis: Preliminary follow-up results at 6-months. Exp Ther Med. 2021 Jun;21(6):598. doi: 10.3892/etm.2021.10030. Epub 2021 Apr 11. PMID: 33884036; PMCID: PMC8056115.
17. Chou SH, Shih CL. Efficacy of different platelet-rich plasma injections in the treatment of mild-moderate knee osteoarthritis: A systematic review and meta-analysis. Int J Clin Pract. 2021 Jun;75(6):e14068. doi: 10.1111/ijcp.14068. Epub 2021 Feb 11. PMID: 33544424.
18. Singh A, Chakravarty S, Sehgal D, Rust B, Sharieff KA. Optimal Dosage of Platelet-Rich Plasma Injections in Patients With Osteoarthritis of the Knee: A Scoping Review. Cureus. 2024 Dec 10;16(12):e75497. doi: 10.7759/cureus.75497. PMID: 39803130; PMCID: PMC11717558.
19. Xiong Y, Gong C, Peng X, Liu X, Su X, et al. Efficacy and safety of platelet-rich plasma injections for the treatment of osteoarthritis: a systematic review and meta-analysis of randomized controlled trials. Front Med (Lausanne). 2023 Jun 27;10:1204144. doi: 10.3389/fmed.2023.1204144. PMID: 37441691; PMCID: PMC10333515.
20. Arita A, Tobita M. Adverse events related to platelet-rich plasma therapy and future issues to be resolved. Regen Ther. 2024 Jul 20;26:496-501. doi: 10.1016/j.reth.2024.07.004. PMID: 39100535; PMCID: PMC11295534.
21. McLarnon M, Heron N. Intra-articular platelet-rich plasma injections versus intra-articular corticosteroid injections for symptomatic management of knee osteoarthritis: systematic review and meta-analysis. BMC Musculoskelet Disord. 2021 Jun 16;22(1):550. doi: 10.1186/s12891-021-04308-3. PMID: 34134679; PMCID: PMC8208610.
22. Gökçeoğlu YS, Yapti M, Öncel F, Levent A, Demir S. Comparative efficacy of intra-articular platelet-rich plasma, hyaluronic acid, corticosteroids, and NSAIDs for knee osteoarthritis: A retrospective cohort study. Medicine (Baltimore). 2025 Oct 3;104(40):e44929. doi: 10.1097/MD.0000000000044929. PMID: 41054168; PMCID: PMC12499739.

| Authors' Contribution | |
|---|---|
| Tabinda Qamar | conceived, Concept design and Definition of intellectual content, literature search |
| Shua Nasir, Urooj Zafar Kulsoom Bibi | Write up, data acquisition and manuscript preparation |
| Shua Nasir, Nur ul Haq | final review of article. |
| Kulsoom Bibi, | final layout, and data entry. |
| Omaimah Siddiqui | References |