TPM Vol. 32, No. S1, 2025
ISSN: 1972-6325
https://www.tpmap.org/

A PROSPECTIVE COMPARATIVE STUDY ON THE EFFICACY OF STEROID VERSUS PLATELET-RICH PLASMA (PRP) INJECTION VERSUS GROWTH FACTOR CONCENTRATE IN THE MANAGEMENT OF OSTEOARTHRITIS KNEE

SAJITH S[1], SABARISHWARAN[1], SANJAY R[1], BALAJI M B[2], S.VIMAL[2], DR.J.JEEVARATHAN[3]

[1]DEPARTMENT OF ORTHOPAEDICS, SAVEETHA MEDICAL COLLEGE & HOSPITAL, SAVEETHA INSTITUTE OF MEDICAL AND TECHNICAL SCIENCES, SAVEETHA UNIVERSITY, THANDALAM, KANCHIPURAM – 602105, TAMIL NADU, INDIA.

[2]DEPARTMENT OF BIOCHEMISTRY, SAVEETHA MEDICAL COLLEGE & HOSPITAL, SAVEETHA INSTITUTE OF MEDICAL AND TECHNICAL SCIENCES, SAVEETHA UNIVERSITY, THANDALAM, KANCHIPURAM – 602105, TAMIL NADU, INDIA.

[3]PROFESSOR, DEPARTMENT OF PEDIATRIC DENTISTRY, SREE BALAJI DENTAL COLLEGE & HOSPITAL, CHENNAI, INDIA

Abstract

Aim:

Osteoarthritis of the knee is a progressive, degenerative joint disorder leading to chronic pain, stiffness, and functional disability among older adults. The disease process involves a complex interplay of mechanical, biochemical, and genetic factors that result in cartilage degradation and joint space narrowing. Intra-articular injections have gained popularity in patients unresponsive to conservative measures and include corticosteroids, platelet-rich plasma (PRP), and growth factor concentrates (GFC). This study is conducted to compare the clinical efficacy and safety of intra-articular corticosteroid, platelet-rich plasma (PRP), and growth factor concentrate (GFC) injections in the management of knee osteoarthritis.

Materials and Methods:

This prospective comparative study was conducted at Saveetha Medical College over a 2-year period from January 2023 to January 2025. A total of 150 patients with Kellgren-Lawrence Grade I–III primary knee osteoarthritis were randomly allocated into three groups (n = 50 each). Group A received a single intra-articular injection of triamcinolone acetonide (40 mg/mL), Group B received 5 mL of autologous PRP, and Group C received 5 mL of autologous GFC. Clinical outcomes were assessed using the Visual Analog Scale (VAS) and Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) at baseline, 1 month, 3 months, and 6 months. Patient satisfaction and adverse events were also recorded.

Results:

All three groups showed initial improvement in pain and function. At 6 months, Group C (GFC) demonstrated the most significant and sustained improvement in VAS (3.3 ± 0.8) and WOMAC scores (33.2 ± 4.3), followed by Group B (PRP) with VAS 4.1 ± 1.2 and WOMAC 39.1 ± 5.8, and Group A (Steroid) with VAS 5.9 ± 1.3 and WOMAC 51.6 ± 6.7 ($p < 0.001$). Patient satisfaction was highest in the GFC group (70% highly satisfied), and no serious adverse events were observed.

Conclusion:

Growth factor concentrate (GFC) injections provided the most effective and sustained pain relief and functional improvement among the three treatment options studied. PRP was moderately effective, while corticosteroids offered only short-term benefit. GFC can be considered a promising biological therapy for early to moderate knee osteoarthritis.

Keywords:
Knee osteoarthritis, intra-articular injection, corticosteroid, platelet-rich plasma, growth factor concentrate, PRP, GFC, pain relief, regenerative therapy.

INTRODUCTION

Osteoarthritis (OA) of the knee is a progressive, degenerative joint disorder involving the breakdown of articular cartilage, remodeling of subchondral bone, synovial inflammation, and formation of osteophytes, resulting in chronic pain, stiffness, and functional disability. It is the most common form of arthritis globally and a major cause of disability in older adults, with prevalence increasing due to aging populations and rising obesity rates. OA is classified into primary (idiopathic) and secondary forms, the latter associated with mechanical, biochemical, or genetic factors. The present study design is illustrated in **Figure 1.**[2] [3]. Radiographic classification is most commonly done using the Kellgren-Lawrence grading system, which categorizes the severity of OA [4].

Management of knee OA ranges from conservative to surgical approaches. Non-pharmacological treatments include weight reduction, physical therapy, bracing, and activity modifications. Pharmacological therapies encompass analgesics, nonsteroidal anti-inflammatory drugs (NSAIDs), and symptomatic slow-acting drugs in osteoarthritis (SYSADOAs) like glucosamine and chondroitin [5]. Intra-articular injections have gained popularity in patients unresponsive to conservative measures and include corticosteroids, hyaluronic acid, platelet-rich plasma (PRP), and growth factor concentrates (GFC). When these fail, surgical interventions such as high tibial osteotomy, unicompartmental knee replacement, or total knee arthroplasty are considered [6].

Corticosteroid injections have been used for decades and provide rapid relief of inflammation and pain by inhibiting prostaglandin synthesis and suppressing immune cell activity [7]. However, repeated steroid use has been associated with chondrotoxicity and cartilage volume loss, raising concerns about long-term safety [8].

Platelet-rich plasma (PRP) is an autologous concentrate of platelets suspended in plasma, rich in growth factors like PDGF, TGF-β, and VEGF, which promote cartilage regeneration, reduce inflammation, and modulate pain [9]. Clinical studies have shown superior and longer-lasting effects of PRP over steroids, particularly in early to moderate OA [10].

Growth Factor Concentrate (GFC) is an advanced biological formulation derived from autologous blood and enriched with specific growth factors that are selectively released from activated platelets. GFC is believed to offer a more potent and targeted therapeutic effect than traditional PRP due to controlled activation and sustained release of growth-promoting molecules [11].

Despite the wide array of intra-articular therapies available, there is still no consensus on the most effective treatment for knee OA. Most existing literature focuses on pair wise comparisons (e.g., PRP vs. steroids), with limited data comparing all three — steroids, PRP, and GFC — within a single prospective framework. Moreover, patient-specific factors, OA grade, and product preparation techniques contribute to significant variability in outcomes, necessitating further head-to-head comparative trials [12].This study aims to bridge this knowledge gap by prospectively comparing the efficacy, duration of symptom relief, and safety profile of intra-articular steroid, PRP, and GFC injections in patients with knee OA. The findings of this study could guide clinicians in making informed, evidence-based decisions regarding biological therapies and potentially offer an individualized treatment algorithm for managing knee OA.

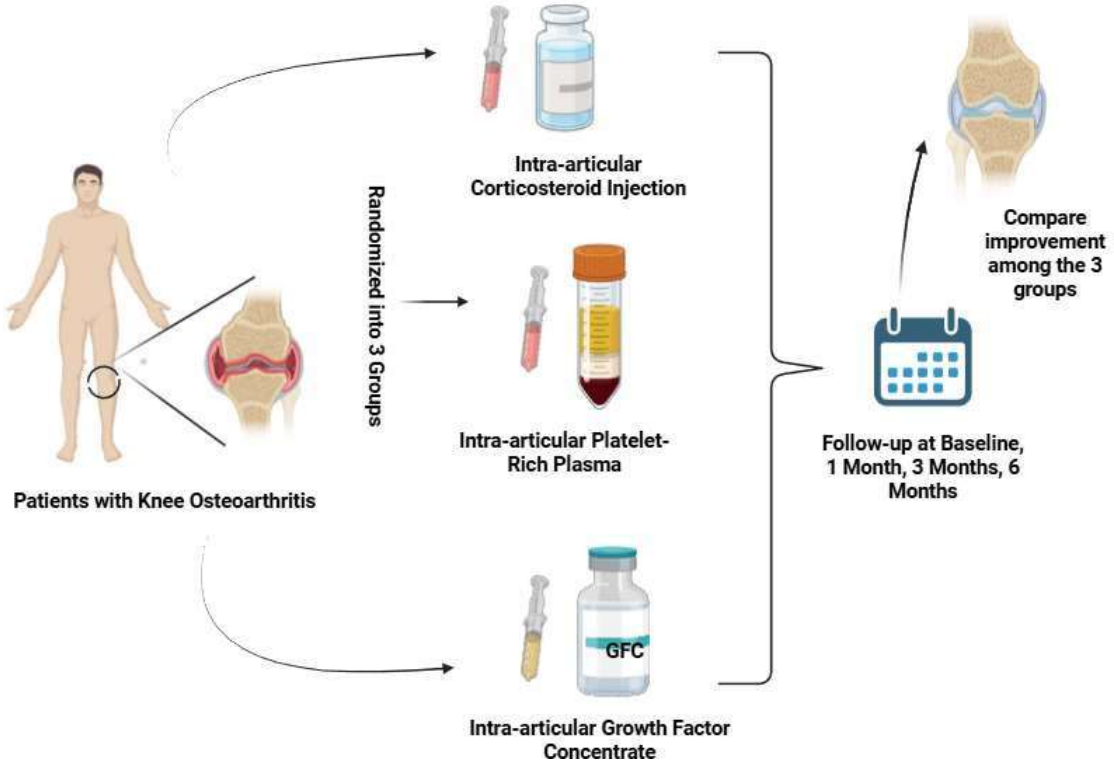


Figure 1. Study design showing randomization of knee osteoarthritis patients into three groups: corticosteroid, PRP, and GFC injections. Follow-up at baseline, 1, 3, and 6 months to compare outcomes among groups.

MATERIALS AND METHODS

Study Design:
This was a prospective comparative interventional study conducted at the Department of Orthopaedics, Saveetha Medical College and Hospital, Chennai, over a period of two years from January 2023 to January 2025. The study was approved by the Institutional Ethical Committee, and written informed consent was obtained from all participants prior to enrolment. was used to allocate participants into the three study groups using a computer-generated randomization sequence.

Study Population:
A total of 150 patients diagnosed with primary knee osteoarthritis were included in the study using Simple random sampling and were randomly allocated into three equal groups (n = 50 in each group):

- Group A: Intra-articular corticosteroid injection
- Group B: Intra-articular platelet-rich plasma (PRP) injection
- Group C: Intra-articular growth factor concentrate (GFC) injection

Inclusion Criteria:

- Patients aged between 40 and 75 years.
- Diagnosed with primary osteoarthritis of the knee based on clinical and radiological features (Kellgren-Lawrence Grades I–III).
- Persistent knee pain for more than 3 months despite conservative management.
- Willing to participate and provide informed consent.

Exclusion Criteria:

- Patients with secondary osteoarthritis (post-traumatic, inflammatory, septic arthritis, rheumatoid arthritis, or gout).
- Patients with Kellgren-Lawrence Grade IV osteoarthritis.
- Prior intra-articular injection to the knee within the last 6 months.

- Patients who have undergone knee surgery or arthroplasty.
- Patients with bleeding disorders, active infection, or malignancy.
- Patients on anticoagulants or immunosuppressive therapy.
- Pregnant or lactating women.

Procedure:
Baseline assessment included clinical history, physical examination, radiographic evaluation using the Kellgren-Lawrence classification, and baseline pain and function scores using Visual Analog Scale (VAS) and WOMAC index.

- Group A: Received a single intra-articular injection of 2 mL triamcinolone acetonide (40 mg/mL) under aseptic precautions.
- Group B: Received a single injection of 5 mL autologous PRP, prepared using a standardized double-spin centrifugation protocol.
- Group C: Received a single injection of 5 mL autologous GFC, prepared using commercially available kits for platelet activation and growth factor extraction.

All patients were followed at 1 month, 3 months, and 6 months post-injection. Pain relief and functional outcomes were assessed using:Visual Analog Scale (VAS), WOMAC (Western Ontario and McMaster Universities Osteoarthritis Index).Primary Outcomeis measured reduction in VAS score at 6 months. Secondary Outcomes is measured byimprovement in WOMAC score, patient satisfaction, and occurrence of adverse events.

Statistical Analysis:
Data were compiled and analysed using SPSS version 25.0. Continuous variables were expressed as mean ± standard deviation. Categorical data were expressed as percentages. ANOVA and post-hoc Tukey tests were used to compare mean scores between groups. A p-value of <0.05 was considered statistically significant.

RESULTS

A total of 150 patients diagnosed with primary knee osteoarthritis were included in the study and equally divided into three groups: Group A (Steroid injection), Group B (Platelet-Rich Plasma injection), and Group C (Growth Factor Concentrate injection), with 50 patients in each group. The mean age of participants was 59.2 ± 8.1 years, and 62% were female. Baseline demographic and clinical characteristics, including age, gender distribution, and Kellgren-Lawrence grading, were comparable across all groups ($p > 0.05$). At baseline, mean Visual Analog Scale (VAS) scores were similar across the groups (Group A: 7.8 ± 1.1, Group B: 7.6 ± 1.2, Group C: 7.7 ± 1.0; $p = 0.71$). At 1-month follow-up, pain scores improved in all groups, with Group C showing slightly better relief (VAS: 3.9 ± 1.2) compared to Group A (4.2 ± 1.0) and Group B (4.5 ± 1.1), nearing statistical significance ($p = 0.05$). By 3 months, Group A showed a worsening trend (VAS: 4.8 ± 1.2), while Group B and C continued to show improvement (VAS: 3.5 ± 1.1 and 3.1 ± 0.9, respectively), with significant difference between the groups ($p < 0.001$). At 6 months, Group C maintained the most sustained pain relief (VAS: 3.3 ± 0.8), followed by Group B (VAS: 4.1 ± 1.2), while Group A experienced recurrence of symptoms (VAS: 5.9 ± 1.3), with the difference being highly significant ($p < 0.001$). Follow – up Comparison betweenVAS Scores of Steroid vs PRP vs GFC is shown in Figure 1.

Functional outcomes as measured by the WOMAC score followed a similar trend. At baseline, scores were comparable across all groups (Group A: 64.7 ± 6.4, Group B: 65.2 ± 5.9, Group C: 63.8 ± 6.1; $p = 0.54$). At 3 months, Group C had the greatest improvement (WOMAC: 34.8 ± 4.6), followed by Group B (37.3 ± 5.2), while Group A lagged behind (43.5 ± 5.1), with $p < 0.001$. This trend persisted at 6 months, where Group C showed the best functional outcomes (WOMAC: 33.2 ± 4.3), followed by Group B (39.1 ± 5.8), and Group A (51.6 ± 6.7), with statistically significant difference ($p < 0.001$). Follow – up Comparison between WOMAC Scores of Steroid vs PRP vs GFC is shown in Figure 2.

Regarding patient satisfaction, 70% of patients in Group C reported being highly satisfied, compared to 56% in Group B and only 24% in Group A. Mild, self-limiting post-injection swelling and pain were noted in 6 patients in Group A, 9 in Group B, and 11 in Group C, with no major complications or infections reported in any group. Overall, the study demonstrated that Growth Factor Concentrate injections provided the most significant and sustained improvement in both pain and functional scores at 6 months, with higher patient satisfaction and acceptable safety, followed by PRP, while corticosteroid injections were associated with quicker onset but short-lived relief and higher recurrence of symptoms.

Table - 1 Primary Outcome - Visual Analog Scale (VAS) for pain assessment

Time Point	Group A (Steroid)	Group B (PRP)	Group C (GFC)	p-value
Baseline	7.8 ± 1.1	7.6 ± 1.2	7.7 ± 1.0	0.71
1 Month	4.2 ± 1.0	4.5 ± 1.1	3.9 ± 1.2	0.05
3 Months	4.8 ± 1.2	3.5 ± 1.1	3.1 ± 0.9	<0.001
6 Months	5.9 ± 1.3	4.1 ± 1.2	3.3 ± 0.8	<0.001

Table -2 Secondary Outcome – WOMAC Score

Time Point	Group A (Steroid)	Group B (PRP)	Group C (GFC)	p-value
Baseline	64.7 ± 6.4	65.2 ± 5.9	63.8 ± 6.1	0.54
3 Months	43.5 ± 5.1	37.3 ± 5.2	34.8 ± 4.6	<0.001
6 Months	51.6 ± 6.7	39.1 ± 5.8	33.2 ± 4.3	<0.001

Table – 3 Satisfaction level of the patients after the treatment

Satisfaction Level	Group A (Steroid)	Group B (PRP)	Group C (GFC)
Highly satisfied	12 (24%)	28 (56%)	35 (70%)
Moderately satisfied	20 (40%)	16 (32%)	12 (24%)
Not satisfied	18 (36%)	6 (12%)	3 (6%)

Figure 1 – Follow – up Comparison of VAS Scores of Steroid vs PRP vs GFC

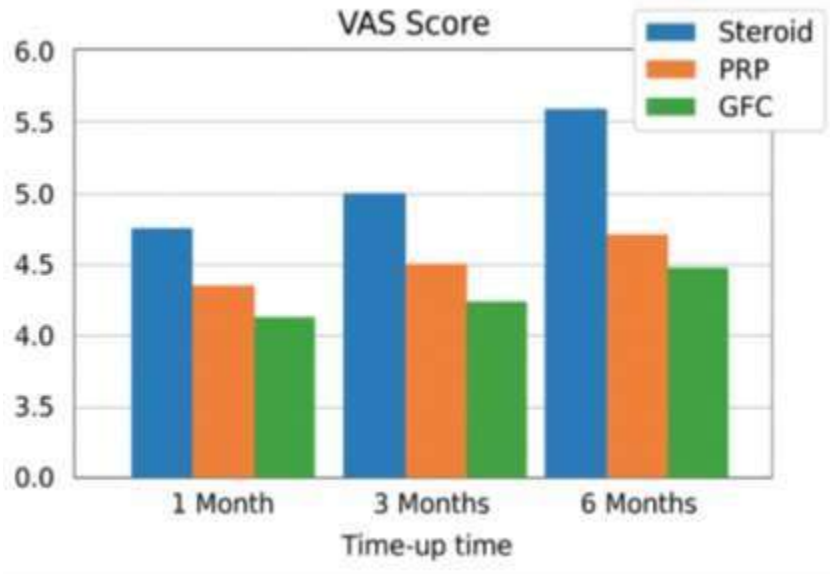
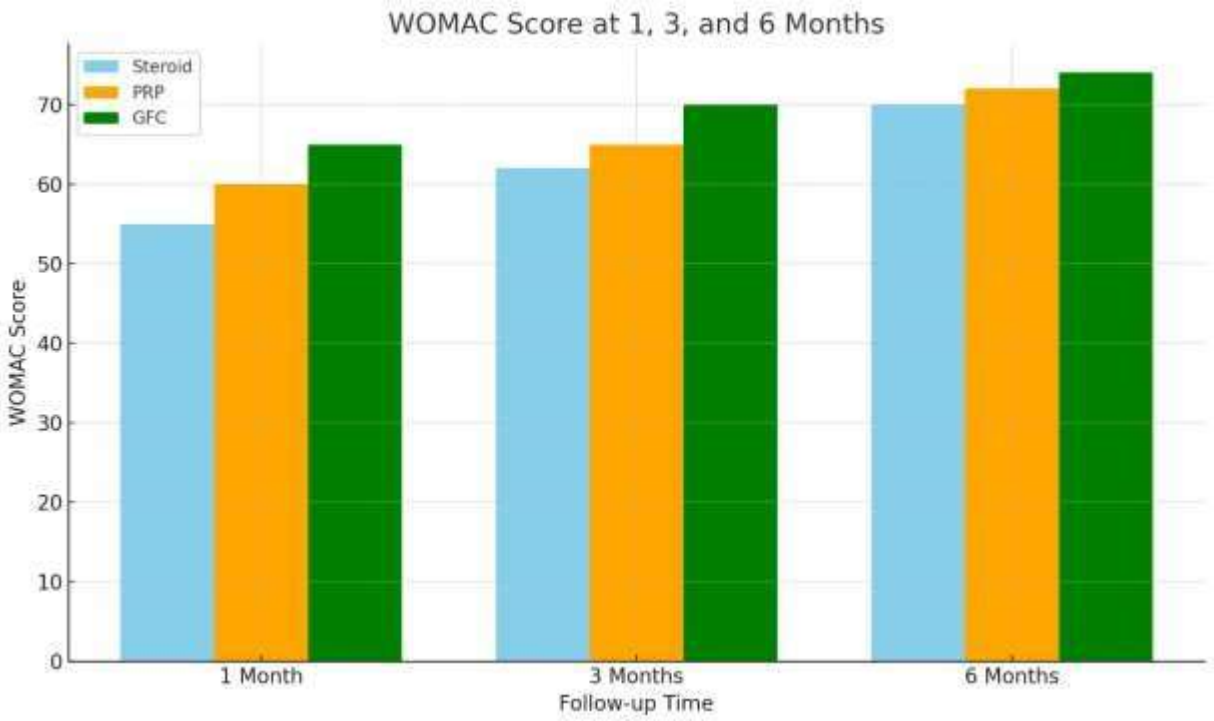


Figure 2 - Follow – up Comparison of WOMAC Scores of Steroid vs PRP vs GFC



DISCUSSION

Osteoarthritis (OA) of the knee is a chronic degenerative joint disease that significantly impairs quality of life, especially among the aging population. As the prevalence of knee OA continues to rise due to increased life expectancy and obesity, there is an ever-growing demand for effective, safe, and minimally invasive treatment options. Traditional management strategies, such as analgesics and NSAIDs, offer only symptomatic relief, and their long-term use is often limited by adverse gastrointestinal and cardiovascular side effects [13]. While surgical interventions like total knee arthroplasty remain the definitive treatment for end-stage OA, they may not be feasible or acceptable for all patients due to age, comorbidities, financial constraints, or fear of surgery. Hence, there is a critical need to explore and refine intra-articular biological therapies that may delay or avoid the need for surgery in early to moderate OA.

The present study was conducted to compare the efficacy and safety of three commonly used intra-articular injections: corticosteroids, platelet-rich plasma (PRP), and growth factor concentrate (GFC), in patients with primary knee OA. While corticosteroids have been traditionally favoured for their potent anti-inflammatory effects and quick pain relief, studies have raised concerns about their chondrotoxic potential and diminishing efficacy with repeated use [14,15]. PRP, on the other hand, has gained popularity for its regenerative capabilities, offering longer-lasting symptom relief through its autologous concentration of growth factors and anti-inflammatory mediators [16]. GFC, a relatively newer biologic derived from platelet-rich formulations, allows for controlled activation and selective concentration of bioactive growth factors, potentially offering superior clinical outcomes [17].

Several previous studies have examined PRP versus steroids in knee OA. For instance, a randomized controlled trial by Patel et al. reported that PRP injections provided superior symptomatic relief compared to corticosteroids at both 6 months and 1-year follow-up in patients with early OA [18]. Similarly, Raeissadat et al. demonstrated sustained improvement in pain and function with PRP over corticosteroids, particularly in younger patients with lower radiographic grades [19]. However, the literature directly comparing PRP with GFC remains sparse. In a pilot study, Dhillon et al. observed promising outcomes with autologous growth factor concentrate in cartilage disorders, though limited by small sample size and short-term follow-up [20].

Our study's findings are in concordance with these results, showing that PRP and GFC provide superior and longer-lasting relief compared to steroids. Moreover, our data suggest that GFC yields even better outcomes

than PRP in terms of both VAS and WOMAC scores at 3 and 6 months, as well as higher patient satisfaction, supporting the hypothesis that refined growth factor enrichment enhances regenerative potential. While the steroid group exhibited rapid pain relief initially, their effects waned by the third month, highlighting their limited utility in long-term OA management.

A key strength of our study lies in its prospective, randomized, comparative design with a robust sample size of 150 patients and standardized outcome measures assessed at multiple time points. Unlike many previous studies that evaluated two interventions in isolation, our study simultaneously compared all three popular intra-articular options in a uniform clinical setting, thus providing more practical and comprehensive insights. By conducting this research in a tertiary care setting like Saveetha Medical College, the results also reflect the realities of patient demographics and treatment outcomes in the Indian population, adding contextual value.For clinicians, this study helps in identifying patient-appropriate biologic therapies based on the stage of OA, expected duration of relief, cost considerations, and individual preferences.

CASE ILLUSTRATIONS

Patient-1

FIGURE 3: LATERAL EDGE OF THE PATELLAR TENDON AT THE LEVEL OF JOINT LINE.

FIGURE 4: IMAGE SHOWING THE LATERAL JOINT SPACE TO FOR THE INTRA-ARTICULAR INJECTION

FIGURE 5: GROUP A - INTRA-ARTICULAR INJECTION OF 2 ML TRIAMCINOLONE ACETONIDE (40 MG/ML) GIVEN UNDER ASEPTIC PRECAUTIONS.

FIGURE 6: GROUP B - INTRA-ARTICULAR INJECTION OF 5 ML AUTOLOGOUS PRP, PREPARED USING A STANDARDIZED DOUBLE-SPIN CENTRIFUGATION PROTOCOL.

FIGURE 7: GROUP C - INTRA-ARTICULAR INJECTION OF 5 ML AUTOLOGOUS GFC, PREPARED USING COMMERCIALLY AVAILABLE KITS FOR PLATELET ACTIVATION AND GROWTH FACTOR EXTRACTION.

CONCLUSION

This study reinforces the growing body of evidence supporting biological therapies for OA knee and presents GFC as a promising new frontier in the regenerative treatment of degenerative joint disease. As biological injections continue to evolve, future studies with longer follow-up and comparative cost-effectiveness analyses will further guide their optimal integration into clinical practice.

Limitations.
The follow-up period was limited to six months, which may not capture the long-term efficacy and durability of the treatments, especially for biological therapies like PRP and GFC. Additionally, the study did not include objective imaging such as MRI to assess structural changes, relying solely on subjective clinical scores like VAS and WOMAC. Lastly, the preparation of PRP and GFC can vary based on individual patient factors, which may influence consistency in outcomes.

REFERENCES

1. Hunter DJ, Bierma-Zeinstra S. Osteoarthritis. *Lancet.* 2019 Apr 27;393(10182):1745-1759.
2. Loeser RF et al. Osteoarthritis: A disease of the joint as an organ. *Arthritis Rheum.* 2012 Jun;64(6):1697-1707.
3. Felson DT et al. Osteoarthritis: New insights. Part 1: The disease and its risk factors. *Ann Intern Med.* 2000;133(8):635–646.
4. Kellgren JH, Lawrence JS. Radiological assessment of osteo-arthrosis. *Ann Rheum Dis.* 1957 Dec;16(4):494-502.
5. Hochberg MC et al. American College of Rheumatology 2019 recommendations for the management of osteoarthritis of the hand, hip, and knee. *Arthritis Care Res.* 2019;71(6):745-759.

6. Bannuru RR et al. OARSI guidelines for the non-surgical management of knee osteoarthritis. *Osteoarthritis Cartilage.* 2019 Nov;27(11):1578-1589.
7. Raynauld JP et al. Safety and efficacy of repeated intra-articular steroid injections in knee osteoarthritis: A randomized, double-blind, placebo-controlled trial. *Arthritis Rheum.* 2003;48(2):370-377.
8. McAlindon TE et al. Effect of intra-articular triamcinolone vs saline on knee cartilage volume and pain. *JAMA.* 2017;317(19):1967-1975.
9. Dhilip A, Parameswari RP. Deciphering the Involvement of Chronic Inflammation in Osteoarthritis: Evaluation of Complement 3 and Cathepsin D in Osteoarthritic Patients-A Retrospective Case Study. *J Pharm Bioallied Sci*. 2024 Apr;16(Suppl 2):S1321-S1325.
10. Filardo G et al. Platelet-rich plasma intra-articular injections for the treatment of degenerative cartilage lesions and osteoarthritis. *Knee Surg Sports TraumatolArthrosc.* 2011 Oct;19(10):528-35.
11. Kon E et al. Platelet-rich plasma for the treatment of knee OA: From bench to bedside. *Sports Med Arthrosc Rev.* 2013 Jun;21(2):62-72.
12. Di Martino A et al. PRP vs hyaluronic acid vs corticosteroids for knee OA: A systematic review and network meta-analysis. *Am J Sports Med.* 2021;49(2):504-516.
13. Hunter DJ, Bierma-Zeinstra S. Osteoarthritis. *Lancet.* 2019;393(10182):1745–1759.
14. Dhilip, Ashita, Parameswari, R. P., Deciphering the Involvement of Chronic Inflammation in Osteoarthritis: Evaluation of Complement 3 and Cathepsin D in Osteoarthritic Patients—A Retrospective Case Study. Journal of Pharmacy and *Bioallied Sciences 16*(Suppl 2):p S1321-S1325, April 2024.
15. Raynauld JP, et al. Safety and efficacy of long-term intraarticular steroid injections. *Arthritis Rheum.* 2003;48(2):370–377.
16. Filardo G, et al. Platelet-rich plasma intra-articular knee injections for the treatment of degenerative cartilage lesions and osteoarthritis. *Knee Surg Sports TraumatolArthrosc.* 2011;19(4):528–535.
17. Kon E, et al. Platelet-rich plasma for the treatment of knee osteoarthritis: from bench to bedside. *Sports Med Arthrosc Rev.* 2013;21(2):62–72.
18. Syed NH, Misbah I, Azlan M, Ahmad Mohd Zain MR, Nurul AA. Exosomes in Osteoarthritis: A Review on Their Isolation Techniques and Therapeutic Potential. *Indian J Orthop*. 2024 May 21;58(7):866-875
19. Raeissadat SA, et al. Intra-articular PRP vs corticosteroids in the management of knee osteoarthritis: A double-blind randomized clinical trial. *Clin Med Insights Arthritis MusculoskeletDisord.*2015;8:1–8.
20. Dhillon MS, et al. Treatment of cartilage defects with autologous growth factors: A pilot study. *Bone Joint Res.* 2013;2(10):203–209.