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ORIGINAL ARTICLE

A Prospective Quasi-Randomized Comparative Study between Intra-Articular Platelet-Rich Plasma and Corticosteroid Injection in Mild to Moderate Knee Osteoarthritis in Patients Aged 40–60 Years: Evaluation of Pain and Functional Outcomes

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ABSTRACT

Background. Knee osteoarthritis is a prevalent degenerative condition that leads to chronic pain, stiffness, and reduced joint function. While corticosteroid (CS) injections are commonly used for rapid relief of symptoms, platelet-rich plasma (PRP) has gained attention as a regenerative treatment with potential longer-lasting effects.

Objective. To evaluate and compare the clinical outcomes of intra-articular PRP and corticosteroid injections in patients with early-stage knee osteoarthritis.

Methodology. A prospective quasi-randomized comparative study was conducted on 84 patients diagnosed with Kellgren-Lawrence grade 1, 2, and 3 knee osteoarthritis. Participants were allocated into two groups: one receiving a PRP injection and the other receiving a corticosteroid injection. Primary outcomes included pain reduction and functional improvement assessed using the Visual Analogue Scale (VAS), Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), and Knee Injury and Osteoarthritis Outcome Score (KOOS) at baseline, one week, six weeks, three months, and six months. A *p*-value of <0.05 was considered statistically significant.

Results. Both treatment groups demonstrated improvement in pain and functional scores following intervention. The corticosteroid group showed more pronounced improvement during the early follow-up period. However, the PRP group exhibited greater and more sustained improvement at later follow-ups, particularly at three and six months, with better overall clinical outcomes.

Conclusion. Corticosteroid injections were effective for immediate relief of symptoms, whereas PRP provided longer-lasting benefits in terms of pain reduction and functional improvement. PRP may therefore be a preferable option for long-term management in patients with mild to moderate knee osteoarthritis.

Keywords. knee osteoarthritis, platelet-rich plasma, triamcinolone, glucocorticoids, intra-articular injections, pain, functional outcome

INTRODUCTION

Knee osteoarthritis (OA) is a progressive degenerative joint disorder characterized by the gradual breakdown of articular cartilage, subchondral bone remodelling, synovial inflammation, and loss of joint function. It is one of the most common causes of chronic pain and disability worldwide, particularly among middle-aged and elderly populations.[1,2] With increasing life expectancy, sedentary lifestyles, and rising obesity rates, the prevalence and burden of knee osteoarthritis continue to grow globally.[2] Patients commonly present with symptoms such as joint pain, stiffness, swelling, reduced mobility, and difficulty performing activities of daily living, all of which significantly impair quality of life.[1]

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Mild to moderate knee osteoarthritis represents an important stage of the disease, as early intervention may help relieve symptoms, improve function, and potentially delay disease progression and the need for surgical intervention.[3] Therefore, identifying safe, effective, and accessible treatment options during this stage remains a major clinical priority.

The pathophysiology of knee osteoarthritis is complex and involves mechanical, biochemical, and inflammatory mechanisms. Degeneration of cartilage results from an imbalance between anabolic and catabolic processes within chondrocytes, leading to progressive matrix breakdown.[4] Inflammatory mediators released within the joint further contribute to cartilage damage and pain, while structural changes such as osteophyte formation, bone marrow lesions, and joint space narrowing exacerbate disease progression.[5] Conventional treatment options, including analgesics, physical therapy, and lifestyle modifications, primarily focus on symptom control rather than altering disease progression.[6] In recent years, intra-articular injection therapies have gained increasing attention due to their targeted delivery and reduced systemic side effects.[6] Among these, corticosteroids and platelet-rich plasma (PRP) have emerged as commonly used interventions for managing symptomatic knee osteoarthritis.

Corticosteroid injections have long been used to reduce inflammation and provide rapid pain relief in patients with osteoarthritis. Their anti-inflammatory properties help suppress inflammatory mediators and reduce synovial inflammation, leading to short-term symptom improvement.[7] However, the duration of benefit is often limited, and repeated injections may carry potential risks, including cartilage damage and systemic effects.[7] In contrast, platelet-rich plasma is a biological therapy derived from autologous blood that contains concentrated platelets and growth factors. These bioactive molecules may promote tissue healing, modulate inflammation, and enhance cartilage regeneration.[8] Several studies have suggested that PRP may provide longer-lasting symptom relief and functional improvement compared to conventional therapies, although results remain variable due to differences in preparation methods and patient characteristics.[9]

Despite the widespread use of both corticosteroid and PRP injections, uncertainty remains regarding their comparative effectiveness, duration of benefit, and overall clinical outcomes in patients with mild to moderate knee osteoarthritis.[9] There is substantial heterogeneity regarding PRP preparation techniques, leukocyte content, patient selection, and duration of follow-up. Moreover, limited prospective comparative studies from Indian tertiary-care settings focusing specifically on mild-to-moderate osteoarthritis are available. Therefore, further prospective evaluation is necessary to assess reproducibility and clinical applicability in defined patient populations.[10] This study aimed to compare the clinical effectiveness of intra-articular platelet-rich plasma and corticosteroid injections in patients with mild to moderate knee osteoarthritis, focusing on pain reduction, functional improvement, and sustainability of therapeutic outcomes.

METHODOLOGY

Study design

This study was a prospective quasi-randomized comparative study to compare the clinical effectiveness of intra-articular platelet-rich plasma (PRP) injections with intra-articular corticosteroid injections in patients with mild to moderate knee osteoarthritis. Participants were divided into two groups: Group A received an intra-articular PRP injection, and Group B received an intra-articular corticosteroid injection. All procedures were performed by the same orthopaedic surgeon to maintain uniformity and reduce inter-observer variability.

Study setting

The study was conducted in the Department of Orthopaedics at GMERS Medical College and General Hospital, Gotri, Vadodara.

Study duration

The study was carried out over a period of 24 months from December 2023 to November 2025.

Study population

Patients attending the orthopaedic outpatient department with complaints suggestive of knee osteoarthritis were screened for eligibility. A total of 84 patients diagnosed with mild to moderate knee osteoarthritis were included in the study.

Inclusion criteria

- Patients aged between 40 and 60 years
- Radiographic diagnosis of knee osteoarthritis grades 1, 2, and 3 according to the Kellgren-Lawrence classification
- Unilateral knee osteoarthritis or bilateral involvement with one knee more symptomatic
- Availability of baseline scoring using Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), Visual Analogue Scale (VAS), and Knee Injury and Osteoarthritis Outcome Score (KOOS) scale

Exclusion criteria

- Immunosuppression or chronic immunocompromised state
- Inflammatory arthritis, including rheumatoid arthritis and gout
- Intra-articular injection within the previous six months
- Known diabetes mellitus
- Bone tumors or metabolic bone diseases
- History of knee arthroscopy within the previous six months

Sample size

The sample size was calculated assuming a prevalence of osteoarthritis of 30%, with a 95% confidence interval and an allowable error of 10%. Based on this calculation, a total sample size of 84 patients was determined. Participants were divided equally into two groups, with 42 patients in the PRP group and 42 patients in the corticosteroid group.

Randomization

Participants were allocated into two groups using an alternate sequence method (Quasi-randomization). Consecutive eligible patients were alternately assigned to either Group A (PRP) or Group B (corticosteroid). This method ensured equal distribution of participants between groups and facilitated feasibility in the outpatient clinical setting.

Intervention protocol

Group A – Platelet-rich plasma injection

Participants in Group A received a single intra-articular injection of 5 ml platelet-rich plasma prepared using a standardized double-spin centrifugation technique as per institutional protocol. Approximately 20 ml of autologous venous blood was collected under aseptic precautions. The first centrifugation was performed at 1500 rpm for 10 minutes, followed by a second centrifugation at 3500 rpm for 10 minutes. The final preparation was leukocyte-poor platelet-rich plasma (LP-PRP) with a platelet concentration approximately 3–5 times the baseline platelet count. The intervention product (IP; in this case, LP-PRP) was administered aseptically into the affected knee joint using fluoroscopic guidance, confirming placement in both antero-posterior and lateral views, targeting the medial compartment.

Group B – Corticosteroid injection

Participants in Group B received a single intra-articular injection of 2 ml (80 mg) triamcinolone acetonide. The IP was administered aseptically using fluoroscopic guidance in both anteroposterior and lateral views, targeting the medial compartment of the knee.

Patients were advised to avoid non-steroidal anti-inflammatory drugs (NSAIDs) and other anti-inflammatory medications for five days before and after injection to prevent interference with platelet activation and treatment response.

Outcome measures

Primary Outcome Measures (reduction in pain and improved functional outcome) were assessed using:

- WOMAC score
- Visual Analogue Scale (VAS)
- KOOS scale

Secondary outcomes included:

- Functional improvement in mobility of the joint
- Duration of relief of symptoms

Assessment tools

WOMAC Index**:** The WOMAC index was used to evaluate pain, stiffness, and physical function. The scores were converted to a percentage scale.

KOOS Scale: The KOOS questionnaire assessed pain, symptoms, activities of daily living, sport and recreation function, and knee-related quality of life. Scores ranged from 0 to 100.

Visual Analogue Scale (VAS)**:** Pain intensity was measured on a scale from 0 (no pain) to 10 (worst imaginable pain).

Kellgren-Lawrence Classification: Radiographic grading was performed using the Kellgren-Lawrence classification to determine the severity of osteoarthritis.

Follow-up schedule

Patients were evaluated at the following intervals:

- Baseline (pre-injection)
- One week
- Six weeks
- Three months
- Six months

At each follow-up, WOMAC, VAS, and KOOS scores were recorded along with range of motion, joint tenderness, crepitus, and joint stability.

Ethical Considerations

Written informed consent was obtained from all participants before enrollment. The study was approved by the Institutional Human Ethics Committee of GMERS Medical College and Hospital, Gotri, Vadodara (IHEC/25/OUT/SRPG0215). Confidentiality of patient data was maintained throughout the study.

Statistical analysis

Data were analyzed using appropriate statistical software. Continuous variables were expressed as mean ± standard deviation, and categorical variables as frequencies and percentages. Intergroup comparisons were performed using Student's t-test and Chi-square test as applicable. A p-value of <0.05 was considered statistically significant. No artificial intelligence-based tools were used for statistical analysis or data interpretation.

RESULTS

A total of 84 patients with mild to moderate knee osteoarthritis were included in the study, with 42 patients allocated to the corticosteroid (CS) group and 42 patients allocated to the platelet-rich plasma (PRP) group.

The sociodemographic characteristics of participants, including age distribution, sex, body mass index (BMI), affected side, Kellgren-Lawrence grade, and associated comorbidities, are presented in Table 1.

Changes in patient recovery parameters over time, including WOMAC score, VAS score, KOOS score, and range of movement, are summarized in Table 2.

At baseline, mean WOMAC scores were 53.00 ± 8.20 in the CS group and 54.55 ± 9.63 in the PRP group, showing no statistically significant difference (p = 0.43). The differences in WOMAC scores between groups at one week (37.45 ± 7.68 vs 49.17 ± 8.23), six weeks (35.26 ± 7.62 vs 40.88 ± 7.71), three months (41.40 ± 7.44 vs 34.48 ± 7.22), and six months (46.38 ± 8.97 vs 31.55 ± 6.86), were statistically significant (p <0.001, p = 0.001, p <0.001, and p <0.001 respectively) (Table 2, Figure 1).

Baseline VAS scores were 7.23 ± 0.798 in the CS group and 6.88 ± 0.878 in the PRP group, with no statistically significant difference (p = 0.056). At one week (4.98 ± 0.841 vs 6.00 ± 0.960) and six weeks (4.68 ± 0.768 vs 5.08 ± 0.800), the differences were statistically significant (p <0.001 and p = 0.023, respectively). At three months (5.75 ± 0.817 vs 4.16 ± 0.730) and six months (6.41 ± 0.909 vs 3.76 ± 0.789), the differences remained statistically significant (both p <0.001) (Table 2, Figure 2).

At baseline, KOOS scores were 55.10 ± 6.431 in the CS group and 53.64 ± 8.234 in the PRP group, with no statistical significance (p = 0.370). At one week (65.86 ± 7.547 vs 57.67 ± 7.250) six weeks (66.38 ± 6.991 vs 61.57 ± 7.768), three months (62.83 ± 6.900 vs 67.76 ± 7.606), and six months (60.00 ± 8.270 vs 68.74 ± 6.652) the differences were statistically significant (p <0.001, p = 0.004, p = 0.003, and p <0.001, respectively) (Table 2, Figure 3).

In addition to statistical significance testing, effect sizes with 95% confidence intervals were calculated for major outcome measures to assess the magnitude and clinical relevance of treatment effects (Table 2).

At the final follow-up at six months, grade I medial joint tenderness was observed in 66.7% of the PRP group and none in the CS group, while grade II tenderness was observed in 33.3% of the CS group and 31% of the PRP group. Grade III tenderness was seen in 66.7% of the CS group as compared to 2.4% of the PRP group. The difference in medial joint tenderness distribution was statistically significant (p <0.001) (Table 3).

No major complications such as septic arthritis, neurovascular injury, or persistent injection-site complications were observed in either group. Mild transient post-injection pain and mild swelling were noted in a few PRP-treated patients and resolved conservatively within 48 hours.

Table 1. Sociodemographic parameter distribution in study participants (N = 84)

Parameters	Corticosteroid		Platelet-rich-plasma		*p*-value
	N	%	N	%	
Age group (years)					
<50	11	26.2	14	33.3	0.768
51-54	16	38.1	14	33.3	
55-60	15	35.7	14	33.3	
Sex					
Female	26	61.9	27	64.3	0.821
Male	16	38.1	15	35.7	
BMI (kg/m²)					
18.5–24.9	6	14.3	7	16.7	0.763
25–29.9	36	85.7	35	83.3	
Laterality					
Left	22	52.4	25	59.5	0.510
Right	20	47.6	17	40.5	
KL grade					
1	11	26.2	10	23.8	0.90
2	18	42.9	20	47.6	
3	13	31.0	12	28.6	
Comorbidities					
Asthma	4	9.5	3	7.1	0.924
Dyslipidemia	2	4.8	3	7.1	
Hypertension	6	14.3	8	19.0	
Hypothyroidism	6	14.3	7	16.7	
None	24	57.1	21	50.0	

BMI = body mass index, KL = Kellgren-Lawrence

DISCUSSION

The present study evaluated and compared the clinical effectiveness of intra-articular platelet-rich plasma (PRP) and corticosteroid (CS) injections in patients with mild to moderate knee osteoarthritis. The present study contributes prospective comparative data from an Indian tertiary-care population with predominantly mild-to-moderate osteoarthritis. The findings demonstrate a distinct difference in the pattern of response between the two treatment modalities, with corticosteroids providing rapid short-term relief, while PRP offers superior and sustained long-term improvement in pain and functional outcomes.

Baseline demographic characteristics in the present study were comparable between both groups, allowing for a reliable comparison of outcomes. The majority of patients were in the fifth and sixth decades of life with a female predominance,

Table 2. Patient recovery parameters change over time distribution in patients (N = 84)

Score	CS, Mean ± SD	PRP, Mean ± SD	Mean Difference (95% CI)	*p*-value
WOMAC				
Baseline	53.00 ± 8.20	54.55 ± 9.63	−1.55 (−5.42 to 2.32)	0.430
1 week	37.45 ± 7.68	49.17 ± 8.23	−11.72 (−15.18 to −8.26)	<0.001*
6 weeks	35.26 ± 7.62	40.88 ± 7.71	−5.62 (−8.90 to −2.34)	0.001*
3 months	41.40 ± 7.44	34.48 ± 7.22	6.92 (3.78 to 10.06)	<0.001*
6 months	46.38 ± 8.97	31.55 ± 6.86	14.83 (11.45 to 18.21)	<0.001*
VAS				
Baseline	7.23 ± 0.798	6.88 ± 0.878	0.35 (−0.01 to 0.71)	0.056
1 week	4.98 ± 0.841	6.00 ± 0.960	−1.02 (−1.41 to −0.63)	<0.001*
6 weeks	4.68 ± 0.768	5.08 ± 0.800	−0.40 (−0.74 to −0.06)	0.023*
3 months	5.75 ± 0.817	4.16 ± 0.730	1.59 (1.25 to 1.93)	<0.001*
6 months	6.41 ± 0.909	3.76 ± 0.789	2.65 (2.29 to 3.01)	<0.001*
KOOS				
Baseline	55.10 ± 6.431	53.64 ± 8.234	1.46 (−1.72 to 4.64)	0.370
1 week	65.86 ± 7.547	57.67 ± 7.250	8.19 (4.98 to 11.40)	<0.001*
6 weeks	66.38 ± 6.991	61.57 ± 7.768	4.81 (1.55 to 8.07)	0.004*
3 months	62.83 ± 6.900	67.76 ± 7.606	−4.93 (−8.12 to −1.74)	0.003*
6 months	60.00 ± 8.270	68.74 ± 6.652	−8.74 (−11.96 to −5.52)	<0.001*
ROM (in degrees)				
Baseline	113.83 ± 8.787	114.76 ± 8.998	−0.93 (−4.79 to 2.93)	0.634
1 week	115.38 ± 9.469	115.64 ± 9.318	−0.26 (−4.28 to 3.76)	0.899
6 weeks	115.50 ± 8.721	115.88 ± 8.926	−0.38 (−4.18 to 3.42)	0.844
3 months	115.36 ± 8.582	117.19 ± 9.072	−1.83 (−5.69 to 2.03)	0.344
6 months	114.57 ± 8.311	117.52 ± 8.937	−2.95 (−6.73 to 0.83)	0.121

**p*-value – statistically significant

WOMAC = Western Ontario and McMaster Universities Osteoarthritis Index, VAS = Visual Analogue Scale, KOOS = Knee Injury and Osteoarthritis Outcome Score, ROM = Range of motion

Table 3. Patient recovery parameters at six months (N = 84)

Parameters	Corticosteroid		Platelet-rich-plasma		*p*-value
	N	%	N	%	
Medial Joint Line Tenderness [11]					
Grade - 1	0	0	28	66.7	<0.001*
Grade - 2	14	33.3	13	31.0	
Grade - 3	28	66.7	1	2.4	
Crepitus					
Mild	27	64.30	22	52.40	0.54
Moderate	10	23.80	13	31.00	
None	5	11.90	7	16.70	
Varus-valgus laxity [12]					
Grade – 0	33	78.60	35	83.30	0.58
Grade – 1	9	21.40	7	16.70	
Anterior-posterior laxity [13]					
Grade – 0	36	85.70	36	85.70	1.00
Grade – 1	6	14.30	6	14.30	

**p*-value – statistically significant

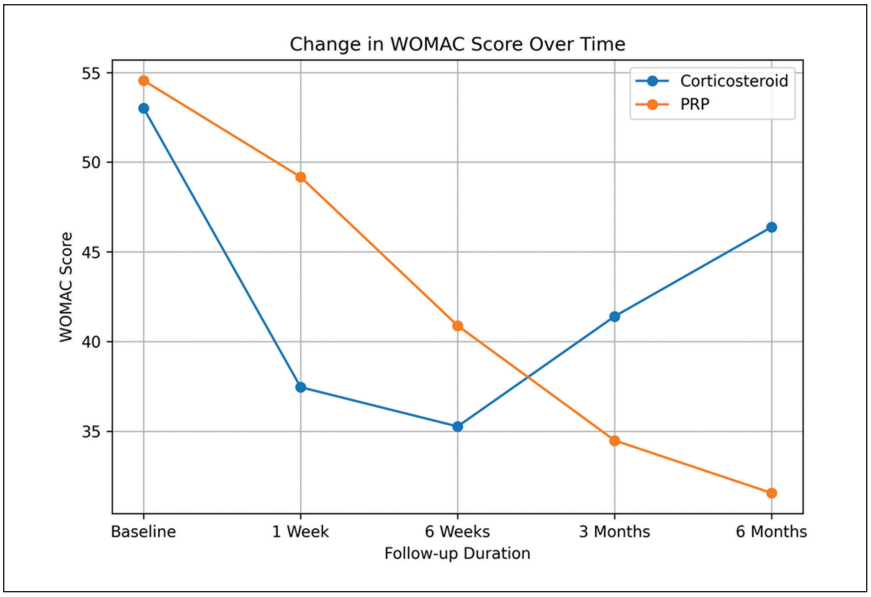


Figure 1. Change in WOMAC score over time (linear distribution) (N = 84).

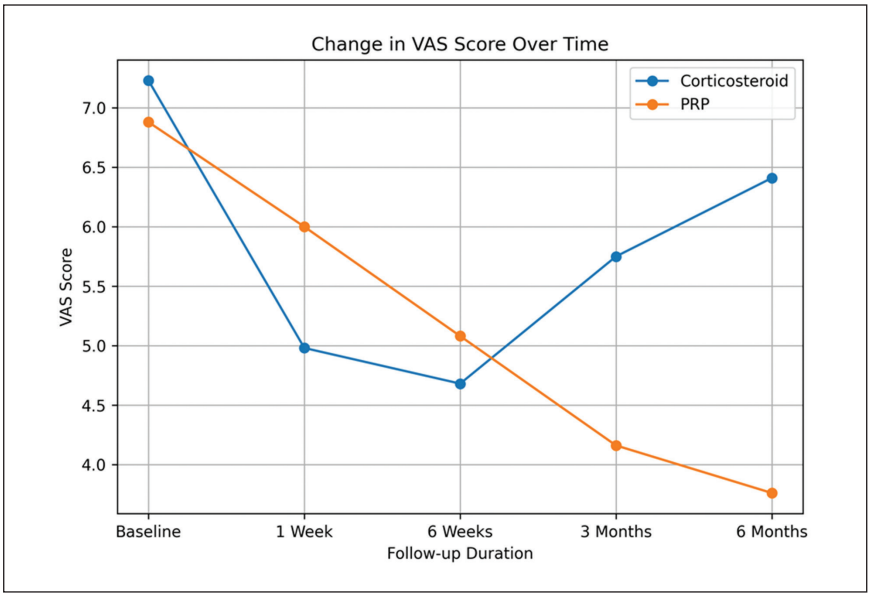


Figure 2. Change in VAS score over time (N = 84).

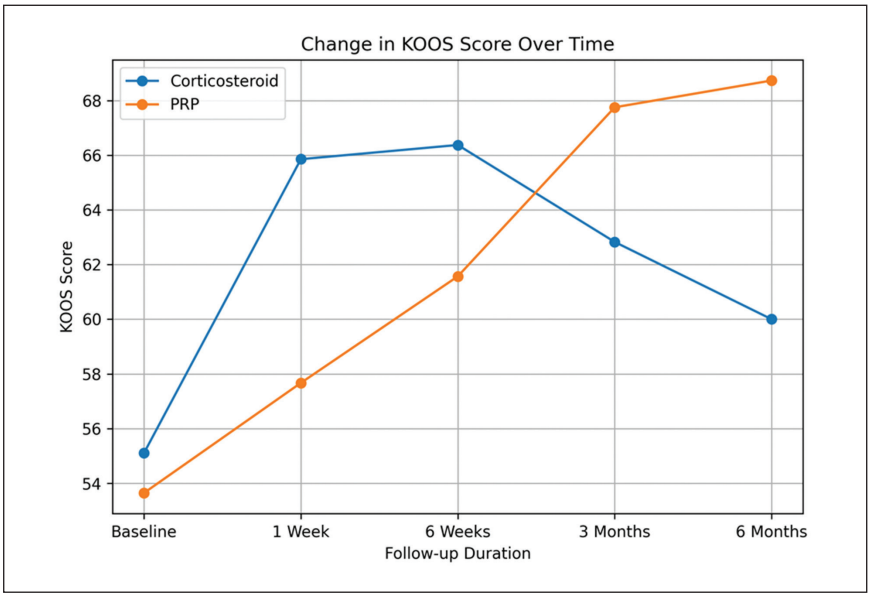


Figure 3. Change in KOOS score over time (N = 84).

which is consistent with the epidemiological profile of knee osteoarthritis reported in previous studies.[14] The high prevalence of overweight individuals in both groups further supports the established association between increased body mass index and osteoarthritis progression.

In the present study, corticosteroid injections showed significant improvement in WOMAC, VAS, and KOOS scores during early follow-up at one week and six weeks. This rapid improvement can be attributed to the potent anti-inflammatory action of corticosteroids, which reduce synovial inflammation and suppress inflammatory mediators within the joint. Similar findings have been reported by Ayhan et al., where corticosteroids provided effective short-term pain relief and functional improvement.[15] However, this benefit declined over time, with reduced efficacy observed at three and six months, respectively, highlighting the transient nature of corticosteroid therapy.

In contrast, PRP injections demonstrated gradual but significantly greater improvement in clinical outcomes at later follow-up periods. At three and six months, PRP showed superior improvement in WOMAC, VAS, and KOOS scores compared to corticosteroids. This sustained effect may be attributed to the biological properties of PRP, which contains growth factors that promote tissue repair, modulate inflammation, and support cartilage homeostasis. Previous studies have similarly reported that PRP provides better long-term pain relief and functional outcomes compared to corticosteroids.[10]

Recent systematic reviews and meta-analyses have further supported these findings. Studies have demonstrated that PRP has a higher probability of improving pain and functional outcomes at mid- and long-term follow-up compared to corticosteroids and other intra-articular therapies.[16] These findings reinforce the results of the present study and highlight the growing role of PRP as a regenerative treatment modality in early osteoarthritis.

Despite improvements in pain and function, no statistically significant difference was observed between the two groups in terms of range of motion. This suggests that intra-articular injections primarily influence symptomatic relief rather than structural joint changes over a short duration. Similar observations have been reported by Ayhan et al.[15]

Although the findings of the present study are consistent with most of the available literature, the lack of standardization remains a major limitation in the widespread application of PRP therapy and requires further investigation.[17]

The present findings are consistent with previously reported pharmacodynamic trends wherein corticosteroid injections provide superior short-term symptomatic relief, while platelet-rich plasma (PRP) demonstrates better sustained improvement at mid-term and long-term follow-up. Recent randomized controlled trials and systematic reviews published after 2020 have similarly reported superior functional and pain-related outcomes with PRP compared to corticosteroid injections in patients with knee osteoarthritis. However, considerable heterogeneity persists across available literature regarding PRP preparation protocols, leukocyte concentration, platelet count, and patient selection criteria, limiting direct comparison between studies. The present study further contributes prospective comparative data from an Indian tertiary-care population with predominantly mild-to-moderate osteoarthritis and lower Kellgren-Lawrence grades. Additionally, the relatively younger age group included in the present study may partially explain the favorable response observed with PRP therapy, as biologic treatment modalities may demonstrate greater regenerative potential in early-stage osteoarthritis.[18]

STUDY LIMITATIONS

This study has certain limitations. It was conducted at a single center with a relatively small sample size, which may limit the generalization to the common population. The quasi-randomized alternate allocation method may introduce selection bias. The sample size may be underpowered for WOMAC-based subgroup analysis. In addition, the study was not blinded, which may have influenced subjective outcome assessment measures. The follow-up duration was limited to six months and may not reflect long-term outcomes for a chronic degenerative condition. Besides, Magnetic Resonance Imaging (MRI) was not performed at baseline or at the endpoint of the study, which may have provided additional information on the potential of PRP in cartilage regeneration. Potential confounding factors, including patient activity level and adherence to lifestyle modifications, were not strictly controlled.

CONCLUSION

The findings of the present study demonstrate that intra-articular corticosteroid injections provided rapid but short-term relief in patients with mild to moderate knee osteoarthritis, whereas platelet-rich plasma injections resulted in gradual yet more sustained improvement in pain and functional outcomes. Although both modalities were effective, PRP showed superior long-term benefits and may be considered a more favorable therapeutic option for ongoing symptom management. These results support the growing role of biologic therapies in early osteoarthritis and highlight the need for further large-scale studies with longer follow-up to establish standardized treatment protocols.

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The authors utilized ChatGPT (an AI tool) for language editing and improvement of manuscript readability. No AI tools were used for data analysis or figure generation. All content has been reviewed and finalized by the authors.

STATEMENT OF AUTHORSHIP

All authors certified fulfillment of ICMJE (International Committee of Medical Journal Editors) authorship criteria.

CREDIT AUTHOR STATEMENT

CVT: Conceptualization, Methodology, Writing – review and editing; **BCR:** Conceptualization, Methodology, Formal analysis, Investigation, Data curation, Writing – original draft preparation, Writing – review and editing; **MAP:** Methodology, Validation, Formal analysis, Writing – original draft preparation, Writing – review and editing; **HBR:** Formal analysis, Investigation, Data curation, Writing – review and editing; **SKP:** Validation, Writing – review and editing.

DATA AVAILABILITY STATEMENT

The datasets generated and/or analyzed during the current study are not publicly available due to patient confidentiality and lack of consent for data sharing, but are available from the corresponding author on reasonable request.

AUTHOR DISCLOSURE

The authors declared no conflict of interest.

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None.

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