Effectiveness of Platelet-Rich Plasma versus Intra-articular Steroid Injections in Advanced Knee Osteoarthritis – A Prospective Observational Study from Eastern India

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ABSTRACT

Introduction: Intra-articular corticosteroids have shown promise for longer-lasting benefits in knee osteoarthritis (OA), but with limited evidence from Indian context. This study compared pain and functional outcomes at 6 months following PRP versus steroid injections in OA patients.

Materials and methods: This prospective observational study was conducted at a tertiary hospital in eastern India from January to December 2023. Patients aged ≥50 years with Kellgren-Lawrence Grade I to III OA were enrolled and allocated to platelet-rich plasma (PRP) or steroid groups based on preference and feasibility. Patients were followed at one, three and six months. Pain and function were evaluated by visual analogue scale (VAS), and Western Ontario and McMaster Universities Arthritis Index (WOMAC), respectively.

Results: 140 patients were enrolled- 70 in the PRP group (50%) and 70 in the steroid group (50%). Mean age of participants was 61.8±7.9 years, majority female (n=82, 58.6%). The PRP group demonstrated greater and more sustained reduction in pain compared to the steroid group at 3 and 6 months The mean VAS score in the PRP group was lower by 1.5 (1.0 to 2.0) and 1.7 (1.2 to 2.3), respectively, during end of third and six months compared to the steroid groups. Similarly, WOMAC score was lower in the PRP group by 7.8 (4.7 to 10.9) and 9.2 (5.9 to 12.5) at the same time.

Conclusion: PRP and steroid injections both improved outcomes in advanced OA, with PRP showing superior and sustained benefits at 6 months. Steroids offered quicker but shorter relief.

Keywords:
India, intra-articular injections, knee joint, osteoarthritis, platelet-rich plasma

INTRODUCTION

Knee osteoarthritis (OA) is one of the most prevalent musculoskeletal disorders worldwide[1]. It is characterised by progressive cartilage degradation, joint space narrowing, osteophyte formation, and chronic inflammation. OA significantly limits mobility and affects the quality of life, especially in older adults[2]. Current treatment options include non-pharmacologic measures like physiotherapy and weight reduction, pharmacologic agents such as non-steroidal anti-inflammatory drugs (NSAIDs), and intra-articular corticosteroids for symptom relief. While corticosteroid injections are commonly used for short-term pain management, repeated use may accelerate cartilage degeneration and offer only temporary benefit[2,3].

In recent years, newer biological therapies such as platelet-rich plasma (PRP) have gained attention for managing OA. PRP is derived from the patient's own blood and contains a high concentration of growth factors and cytokines that can potentially reduce inflammation and promote cartilage repair[4-6]. Several studies have shown that PRP may provide longer-lasting pain relief and improved joint function when compared to corticosteroids or hyaluronic acid, especially in early to moderate stages of OA[7,8]. However, there is still limited evidence regarding its effectiveness in advanced OA, particularly when compared directly to steroid injections in a real-world clinical setting[9].

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In India, the burden of OA is rapidly increasing due to rising life expectancy, sedentary lifestyles, and higher rates of obesity. A significant proportion of patients present at advanced stages due to delayed care-seeking behaviour and limited access to specialised services[10]. Intra-articular steroid injections remain the more commonly used treatment option in public sector hospitals due to low cost and ease of administration. PRP therapy, although increasingly available in private practice, is underutilised in government settings due to cost and limited awareness among practitioners. There is a lack of prospective comparative data on PRP and steroid injections in advanced knee OA from Indian tertiary care centres. This limits the formulation of context-specific treatment guidelines for broader adoption. In this background, this study a prospective study was conducted to compare the functional outcomes at six months following intra-articular platelet-rich plasma injections versus intra-articular steroid injections in patients with knee osteoarthritis attending a tertiary care medical college hospital in eastern India.

MATERIALS AND METHODS

This was a prospective, observational, comparative study conducted in the Department of Orthopaedics at a tertiary care medical college hospital in eastern India.

The study was conducted over a 12-month period from January 2023 to December 2023. Patients aged 50 years and above with clinically and radiologically confirmed knee osteoarthritis (Kellgren-Lawrence Grade I to III) were eligible for the study. Patients with prior intra-articular injections in the last six months, inflammatory arthritis, bleeding disorders, uncontrolled diabetes mellitus, active local or systemic infection, recent knee trauma or surgery, or known hypersensitivity to corticosteroids were excluded. Eligible patients were counselled about both treatment options- PRP and intra-articular corticosteroids. Based on their preference and financial feasibility, patients were allocated into either the PRP or steroid group. Written informed consent was obtained prior to enrolment.

The sample size was calculated assuming a moderate effect size (Cohen's d = 0.5) in the change of VAS score at 6 months between the two groups. With a power of 80% and a significance level of 5%, the required sample size was 64 patients per group. Accounting for a potential 10% loss to follow-up, the final sample size was 140 patients (70 in each group). Participants were selected by consecutive sampling based on eligibility and willingness to participate.

The primary outcome was pain relief, assessed using the Visual Analog Scale (VAS), a 10-point scale where 0 indicates no pain and 10 indicates the worst imaginable pain. The secondary outcome was functional improvement, assessed using the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC). The WOMAC is a validated, self-administered questionnaire with three domains: pain (5 items), stiffness (2 items), and physical function (17 items). Each item is scored from 0 (no symptoms) to 4 (extreme symptoms), with higher scores indicating worse outcomes. The WOMAC has high internal consistency (Cronbach's alpha >0.8) and has been widely used in OA research for its reliability and responsiveness to change[11]. Other variables collected included age, sex, BMI, laterality of knee involvement, comorbidities (such as diabetes and hypertension), and symptom duration.

Approximately 20mL of venous blood was drawn under aseptic conditions. PRP was prepared using a double-spin method: the first spin at 1500 rpm for 10 minutes, followed by a second spin of the supernatant at 3500 rpm for 10 minutes. The platelet pellet was re-suspended to yield 4-6mL of PRP. The PRP was injected intra-articularly using a superolateral approach under aseptic precautions without ultrasound guidance. Patients in the steroid group received an intra-articular injection of 40mg triamcinolone acetonide, diluted in 2mL normal saline, administered using the anterolateral approach under aseptic conditions. No local anaesthetic was mixed with the steroid to avoid confounding the pain outcomes. Both procedures were performed by experienced orthopaedic surgeons according to the departmental practice for smaller-volume injections. Post-injection, patients were observed for 30 minutes and advised to limit strenuous activity for 24 – 48 hours. NSAIDs were withheld for at least one-week post-injection.

Patients were followed at one month, three months, and six months after the injection. At each follow-up visit, VAS and WOMAC scores were recorded. Patients were also evaluated for adverse events such as joint swelling, stiffness, or signs of infection. Compliance with post-injection instructions and physiotherapy was documented during follow-up visits. All patients were advised a standardised physiotherapy programme comprising quadriceps strengthening, knee range-of-motion exercises, and progressive weight-bearing, supervised initially and then continued at home. Compliance was assessed by self-report and follow-up questioning at each visit. A dedicated study coordinator maintained telephonic contact with patients between visits to ensure adherence and to document any interim complaints or complications.

To reduce selection bias, strict inclusion and exclusion criteria were applied. Although this was not a randomised study, uniform follow-up protocols, standardised injection techniques, and outcome assessments were used to maintain comparability between groups. Data were collected and entered independently by two researchers, and discrepancies were resolved by a third reviewer.

Table I: Baseline characteristics of participants (n=140).

Variable	PRP Group (n=70)	Steroid Group (n=70)	p-value
Age (years), mean ± SD	62.0 ± 8.1	61.5 ± 7.8	0.68
Female, n (%)	41 (58.6%)	41 (58.6%)	1.00
BMI (kg/m²), mean ± SD	27.4 ± 3.2	27.1 ± 3.0	0.45
KL Grade, n (%)			0.72
Grade I	14 (20.0%)	20 (28.5%)	0.48
Grade II	27 (38.6%)	23 (32.9)	
Grade III	29 (41.4%)	27 (38.6%)	
Symptom duration >1 year	44 (62.9%)	47 (67.1%)	0.61

Table II: VAS scores change over time.

Time Point	PRP Group (Mean ± SD)	Steroid Group (Mean ± SD)	Mean Difference (95% CI)	p-value
Baseline (n=70 each)	7.6 ± 1.1	7.4 ± 1.0	0.2 (–0.2 to 0.6)	0.28
1 month (n=70 each)	4.9 ± 1.3	4.8 ± 1.2	0.1 (–0.3 to 0.5)	0.62
3 months (PRP: n=67, Steroid: n=65)	3.7 ± 1.2	5.2 ± 1.4	–1.5 (–2.0 to –1.0)	<0.001
6 months (PRP: n=65, Steroid: n=62)	3.1 ± 1.2	4.8 ± 1.6	–1.7 (–2.3 to –1.2)	<0.001

Table III: WOMAC total score comparison between groups over time.

Time Point	PRP Group (Mean ± SD)	Steroid Group (Mean ± SD)	Mean Difference (95% CI)	p-value
Baseline (n=70 each)	62.5 ± 8.4	61.8 ± 9.1	0.7 (–2.6 to 4.0)	0.61
1 month (n=70 each)	45.1 ± 7.9	46.2 ± 8.0	–1.1 (–3.9 to 1.7)	0.38
3 months (PRP: n=67, Steroid: n=65)	36.7 ± 8.3	44.5 ± 9.0	–7.8 (–10.9 to –4.7)	<0.001
6 months (PRP: n=65, Steroid: n=62)	32.4 ± 7.8	41.6 ± 9.5	–9.2 (–12.5 to –5.9)	<0.001

Table IV: Adverse events and follow-up compliance.

Outcome	PRP Group (n=70)	Steroid Group (n=70)	p-value
Minor adverse events, n (%)	2 (2.9%)	4 (5.7%)	0.40
Serious adverse events, n (%)	0 (0%)	0 (0%)	–
Completed 6-month follow-up, n (%)	65 (92.9%)	62 (88.6%)	0.41

Data were entered in Microsoft Excel and analysed using SPSS version 26.0 [IBM Corp. Released 2019. IBM SPSS Statistics for Windows, Version 26.0. Armonk, NY: IBM Corp]. Continuous variables were expressed as mean ± standard deviation (SD), and categorical variables as proportions. Between-group comparisons were done using independent t-tests for continuous variables and Chi-square tests for categorical variables. Repeated measures ANOVA was used to assess changes in VAS and WOMAC scores over time within and between the two groups. The mean difference (MD) between the two groups were estimated with appropriate 95% confidence interval (CI). A p-value of <0.05 was considered statistically significant for all the statistical tests.

The study was approved by the Institutional Ethics Committee. The research was conducted in accordance with the Declaration of Helsinki, 2013. Written informed consent was obtained from all participants prior to enrolment.

RESULTS

A total of 168 patients were assessed for eligibility. After applying inclusion and exclusion criteria, 140 patients were enrolled- 70 in the PRP group (50%) and 70 in the steroid group (50%). All patients completed the baseline and one-month assessments. At 3 months, 3 patients in the PRP group (4.3%) and 5 in the steroid group (7.1%) were lost to follow-up. At 6 months, follow-up was completed for 65 patients in the PRP group (92.9%) and 62 in the steroid group (88.6%) (Fig. 1).

Baseline demographic and clinical characteristics were comparable between the two groups (Table I). The mean age of participants was 61.8 ± 7.9 years. The majority were female (58.6%). Both groups had a similar distribution of KL Grade. Physiotherapy compliance at 6 months was 84.6% in the PRP group and 81.4% in the steroid group (p=0.62).

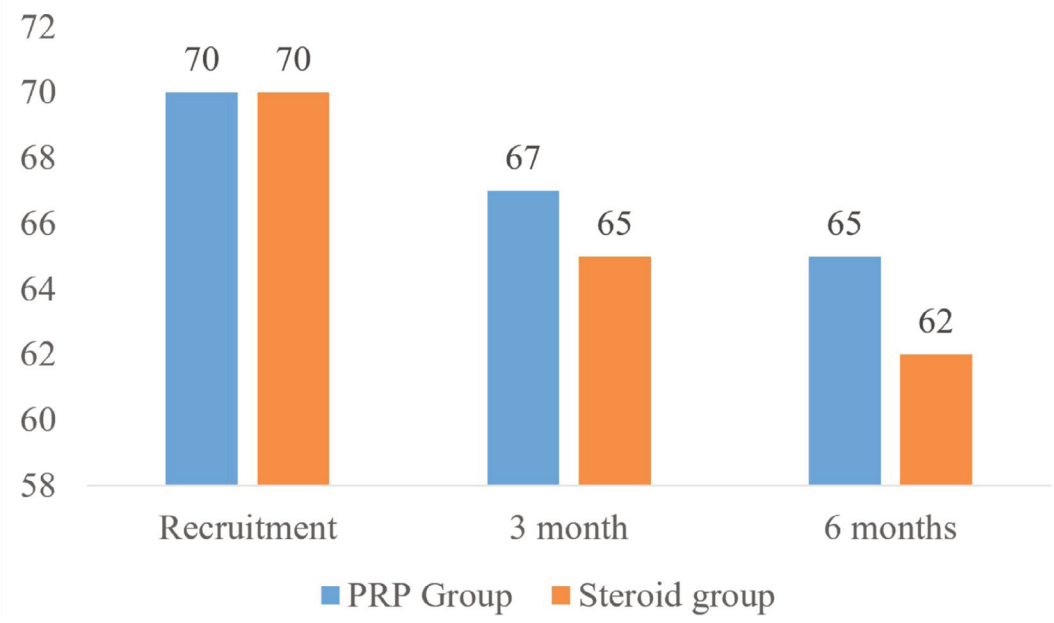

Fig. 1: Follow-up compliance of participants in the PRP and steroid group.

Both groups showed significant improvement in VAS scores from baseline to 6 months ($p<0.001$). However, the PRP group demonstrated greater and more sustained reduction in pain compared to the steroid group at three and six months (Table II). The mean VAS score at the end of six months was 3.1 ± 1.2 in the PRP group vs 4.8 ± 1.6 in the steroid group.

WOMAC scores improved in both groups, with significant reductions in pain, stiffness, and physical function domains. The PRP group showed greater improvement in total WOMAC scores at three and six months (Table III). At 6 months, the mean WOMAC total score was 32.4 ± 7.8 in the PRP group vs 41.6 ± 9.5 in the steroid group.

Minor adverse events were observed in 4 patients in the steroid group (5.7%) (transient post-injection flare, managed conservatively) and in 2 patients in the PRP group (2.9%) (mild stiffness lasting <24 hours). No serious adverse events or infections were reported in either group (Table IV).

DISCUSSION

In this study, 140 patients with advanced knee osteoarthritis were followed for six months after receiving either platelet-rich plasma (PRP) or intra-articular corticosteroid injections. Both groups showed a significant reduction in pain and improvement in function over time. At one month, the steroid group had similar VAS and WOMAC scores compared to the PRP group. However, by the third month, the PRP group showed greater improvement. At six months, the PRP group had significantly better outcomes in both pain and function compared to the steroid group. No major adverse events were reported in either group.

In our study, both PRP and steroid groups showed significant pain reduction over time. The steroid group had greater pain relief at one month. This can be explained by the strong anti-inflammatory action of corticosteroids. They inhibit phospholipase A2, reducing prostaglandin and leukotriene synthesis. This leads to rapid suppression of inflammation and pain[12]. However, this effect is short-lived. By end of three and six months, the PRP group showed better pain control. PRP contains growth factors like platelet-derived growth factor (PDGF) and transforming growth factor-beta (TGF-β). These promote tissue healing, reduce inflammation, and modulate pain pathways over time[6]. A meta-analysis by Shen *et al* showed that PRP provided better long-term pain relief than corticosteroids[13]. Thus, the delayed but sustained pain relief with PRP in our study is supported by its regenerative mechanism.

In our study, WOMAC scores improved in both groups over time. At 1 month, the functional scores were similar between the PRP and steroid groups (45.1 vs 46.2; $p=0.38$). This suggests that early functional improvement was comparable. However, at the end of three and six months, the PRP group showed significantly better functional outcomes. This may be due to the biological actions of PRP. PRP contains growth factors such as transforming growth factor-beta (TGF-β), platelet-derived growth factor (PDGF), and vascular endothelial growth factor (VEGF)[14]. These promote chondrocyte activity, extracellular matrix formation, and synovial healing[6,15]. These processes take time to influence joint function but result in better long-term improvement.

Studies have reported similar delayed functional gains with PRP. Recent evidence suggests that PRP led to greater functional improvement than corticosteroids in patients with

early osteoarthritis[16-19]. A meta-analysis by Dai et al also showed better WOMAC outcomes with PRP compared to steroids at mid- to long-term follow-up[20]. Therefore, our findings are consistent with the known regenerative effects of PRP, which appear to offer sustained functional benefits. However, it should be remembered that the platelet yield and concentration in PRP can vary depending on the patient's baseline platelet count, centrifugation speed and duration, and the preparation system used. Such variations in PRP characteristics may influence clinical outcomes.

Both PRP and steroid injections led to mild adverse effects in our study. The PRP group experienced temporary pain and swelling at the injection site, which resolved within a few days, consistent with previous research[21-24]. In the steroid group, mild joint pain flare-ups were noted, which subsided with conservative treatment. No serious adverse events, such as infections, occurred in either group. While corticosteroid injections are associated with potential long-term side effects, such as cartilage damage, no such effects were observed in the short-term follow-up[25]. Hence, ESSKA-ICRS consensus recommended using PRP in management of OA in patients below 80 years of age[26,27].

Our study included a well-defined cohort of patients with knee osteoarthritis, ensuring relevance to real-world clinical settings. A significant sample size of 140 patients allowed for robust statistical analysis. The study followed patients over six months, providing insights into the long-term effects of PRP and steroid injections. Additionally, standardised protocols were used for interventions, minimising procedural variability.

However, the study had a few limitations. The study was observational and non-randomised, which may have introduced selection bias. Patient allocation was based on preference, potentially affecting comparability between groups. The lack of blinding could have influenced outcome assessments. A longer follow-up period may be needed to assess the sustained effects of PRP and steroids. We did not conduct a subgroup analysis based on KL grade severity, which could have provided additional insights into the differential treatment response across OA severity levels. This was due to the limited sample size within each KL grade, which might have led to underpowered comparisons. Also, socio-economic status data were not collected, and this may have influenced group allocation and treatment outcomes. Patients who could afford PRP might also have better access to physiotherapy, medications, or supplements, and may have higher expectations from the treatment, potentially influencing subjective outcome reporting.

CONCLUSION

Both PRP and steroid injections demonstrated significant improvements in pain relief and functional outcomes in patients with advanced knee osteoarthritis. While PRP showed superior long-term results at three and six months, steroid injections were effective in providing quicker relief. Considering the long-term effectiveness, use of PRP should be routinely considered in Indian healthcare settings. Future studies should also include a cost-effectiveness analysis to assess the financial feasibility of PRP therapy, especially considering its higher initial cost. Evaluating the long-term benefits and cost components would provide a more comprehensive understanding of the treatment options, helping guide healthcare providers in making economically informed decisions for managing knee osteoarthritis.

CONFLICT OF INTEREST

The authors declare no potential conflict of interest.

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