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Original Research Article

Role of Platelet-Rich Plasma (PRP) Injections in the Management of Osteoarthritis of the Knee

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Abstract

Introduction: Osteoarthritis (OA) of the knee is a prevalent degenerative joint disease leading to pain, stiffness, and functional limitation. Conventional treatments offer symptomatic relief but do not reverse cartilage damage. Platelet-rich plasma (PRP), an autologous blood product rich in growth factors, has emerged as a potential regenerative therapy for OA.

Aims: To evaluate the efficacy and safety of intra-articular PRP injections in reducing pain and improving function in patients with knee osteoarthritis.

Materials & Methods: This prospective observational study was conducted over a period of one year at Calcutta National Medical College and Hospital, enrolling 80 adult patients with knee osteoarthritis. Patients were assessed for baseline demographic and clinical characteristics, including age, gender, body mass index (BMI), Kellgren–Lawrence (KL) grade, and duration of osteoarthritis.

Results: Baseline characteristics were comparable between the PRP and control groups in terms of age, gender, BMI, KL grade, and OA duration. PRP treatment resulted in significant improvements in pain, functional scores, and range of motion compared to controls at 1, 3, and 6 months ($p < 0.05$ for all), with reductions in VAS scores from 7.2 ± 1.1 to 3.2 ± 0.9 and improvements in functional scores from 55.4 ± 8.6 to 28.5 ± 5.9, while ROM increased from 110.5 ± 8.2° to 128.2 ± 6.3°. Adverse events were mild and comparable between groups, with no infections reported and overall events occurring in 30% of the PRP group versus 20% of controls ($p = 0.28$).

Conclusion: Intra-articular PRP injections are a safe and effective treatment modality for knee osteoarthritis, providing significant symptomatic relief and functional improvement. While promising, long-term studies with larger sample sizes are needed to establish optimal dosing, frequency, and potential disease-modifying effects. PRP represents a viable regenerative option, particularly in patients inadequately responding to conventional therapy.

Keywords: Knee Osteoarthritis, Platelet-Rich Plasma, PRP, Intra-Articular Injection, Cartilage Regeneration, Pain Management, Functional Outcome.

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Introduction

Osteoarthritis (OA) of the knee is one of the most prevalent musculoskeletal disorders, contributing significantly to pain, disability, and reduced quality of life in adults worldwide [1]. It is characterized by progressive degeneration of articular cartilage, subchondral bone remodeling, synovial inflammation, and osteophyte formation, leading to pain, stiffness, and functional impairment [2]. The incidence of knee OA increases with age, obesity, joint injury, and repetitive mechanical stress, with higher prevalence among women and individuals with genetic predisposition [3].

Conventional management of knee OA primarily focuses on symptom relief and functional improvement. Non-pharmacological strategies such as weight management, physical therapy, and exercise aim to reduce joint stress and maintain mobility. Pharmacological interventions include analgesics, nonsteroidal anti-inflammatory drugs (NSAIDs), and intra-articular corticosteroid injections, which provide temporary relief but do

not alter disease progression [4]. Despite their widespread use, these treatments may be associated with adverse effects, limited efficacy in moderate to severe OA, and the inability to regenerate damaged cartilage [5].

In recent years, regenerative medicine approaches have gained attention for their potential to restore joint tissue and modify disease progression. Platelet-rich plasma (PRP) therapy is a biological treatment that uses autologous blood concentrated with platelets and growth factors, including transforming growth factor-beta (TGF-β), platelet-derived growth factor (PDGF), and vascular endothelial growth factor (VEGF), which are implicated in tissue repair, anti-inflammatory modulation, and cartilage regeneration [6]. PRP is prepared through standardized centrifugation techniques and administered via intra-articular injection directly into the affected knee joint. Clinical studies suggest that PRP injections can reduce pain, improve joint function, and enhance quality of life in patients with knee OA. Meta-analyses and randomized controlled trials have reported superior outcomes with PRP compared to placebo or hyaluronic acid, particularly in patients with early to moderate OA [7,8]. However, variability in preparation methods, platelet concentrations, injection protocols, and the number of treatment sessions complicates the interpretation of results [9]. Despite promising evidence, questions remain regarding the long-term efficacy, optimal dosing, frequency, and standardized protocols for PRP therapy. Further high-quality studies are needed to clarify these parameters and establish PRP as a reliable treatment option for knee OA [10].

Materials and Methods

Study Design: Prospective Observational Study.

Place of study: Calcutta National Medical College and Hospital.

Period of study: 1 Year.

Study Population: The study enrolled 80 adult patients diagnosed with knee osteoarthritis who attended Calcutta National Medical College and Hospital over a one-year period. All participants met the inclusion criteria and provided informed consent to receive platelet-rich plasma (PRP) injections as part of this prospective observational study.

Study Variables

- Age
- Gender
- BMI
- KL Grade
- Duration of OA
- Time Point
- Injection site pain
- Swelling
- Infection
- Joint stiffness

Sample Size: 80 Adult patients with knee osteoarthritis.

Inclusion Criteria

- Adults aged 40-75 years with clinically and radiologically confirmed knee osteoarthritis.
- Patients with persistent knee pain and functional limitation despite conservative treatment.
- Willingness to provide informed consent and comply with follow-up.

Exclusion Criteria

- History of knee surgery or intra-articular injection within the past 6 months.
- Severe osteoarthritis requiring knee replacement (KL grade IV).
- Coagulopathy, platelet disorders, or use of anticoagulants.
- Active infection or systemic inflammatory disease.
- Pregnancy or lactation.
- Allergy to any component used in PRP preparation.

Statistical Analysis: All collected data will be entered and analyzed using statistical software such as SPSS version 25.0. Continuous variables, including pain scores, functional scores, and range of motion, will be expressed as mean ± standard deviation (SD), while categorical variables, such as gender and adverse events, will be presented as frequencies and percentages. Comparisons between pre- and post-treatment outcomes will be performed using paired t-tests for normally distributed continuous data and Wilcoxon signed-rank tests for non-normally distributed data. Between-group comparisons, if applicable, will be conducted using independent t-tests or Mann–Whitney U tests. Categorical variables will be analyzed using the Chi-square test or Fisher's exact test as appropriate. A p-value of <0.05 will be considered statistically significant, and all tests will be two-tailed.

Result

Table 1: Baseline Demographic and Clinical Characteristics of Patients

Variable	PRP Group (n=40)	Control Group (n=40)	p-value
Age (years, mean ± SD)	58.2 ± 8.1	57.6 ± 7.9	0.72
Gender (M/F)	18/22	20/20	0.63
BMI (kg/m², mean ± SD)	27.5 ± 3.2	28.1 ± 3.5	0.45
KL Grade II / III	22 / 18	20 / 20	0.63
Duration of OA (years, mean ± SD)	4.1 ± 1.9	4.3 ± 2.1	0.68

Table 2: Pain Assessment Using Visual Analogue Scale (VAS)

Time Point	PRP Group (Mean ± SD)	Control Group (Mean ± SD)	p-value
Baseline	7.2 ± 1.1	7.1 ± 1.2	0.78
1 month	5.1 ± 1.2	6.3 ± 1.3	0.003
3 months	3.8 ± 1.0	5.9 ± 1.2	<0.001
6 months	3.2 ± 0.9	5.5 ± 1.1	<0.001

Table 3: Functional Outcome Using WOMAC Score

Time Point	PRP Group (Mean ± SD)	Control Group (Mean ± SD)	p-value
Baseline	55.4 ± 8.6	54.8 ± 9.1	0.73
1 month	42.1 ± 7.8	50.3 ± 8.2	0.001
3 months	33.2 ± 6.5	48.7 ± 7.5	<0.001
6 months	28.5 ± 5.9	46.2 ± 7.1	<0.001

Table 4: Knee Range of Motion (Flexion in Degrees)

Time Point	PRP Group (Mean ± SD)	Control Group (Mean ± SD)	p-value
Baseline	110.5 ± 8.2	111.2 ± 7.9	0.65
1 month	118.4 ± 7.5	114.3 ± 8.1	0.02
3 months	124.7 ± 6.8	116.5 ± 7.6	<0.001
6 months	128.2 ± 6.3	117.8 ± 7.2	<0.001

Table 5: Adverse Events

Adverse Event	PRP Group (n=40)	Control Group (n=40)	p-value
Injection site pain	6 (15%)	2 (5%)	0.14
Swelling	4 (10%)	1 (2.5%)	0.17
Infection	0	0	–
Joint stiffness	2 (5%)	5 (12.5%)	0.24
Overall adverse events	12 (30%)	8 (20%)	0.28

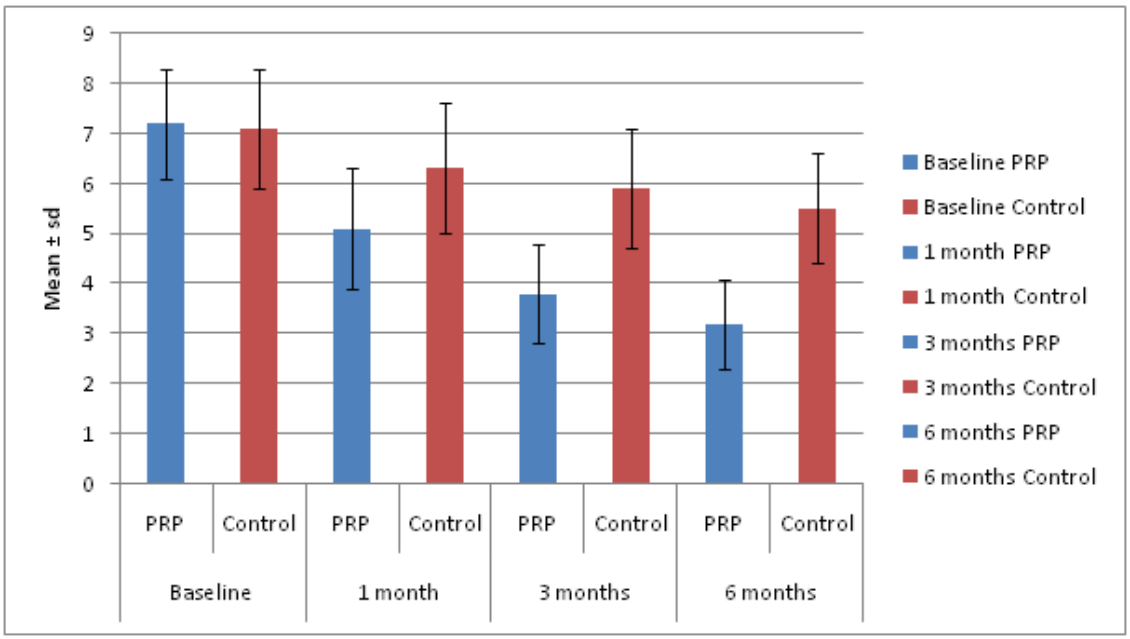

Figure 1: Pain Assessment Using Visual Analogue Scale (VAS)

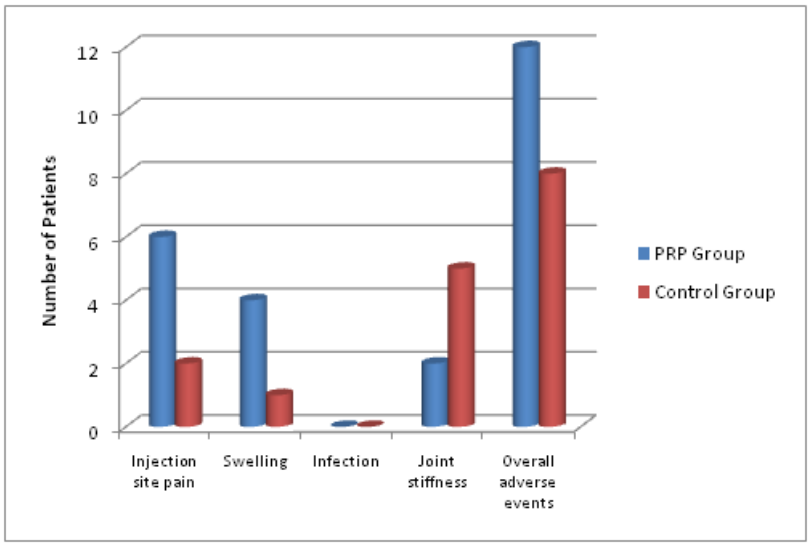

Figure 2: Adverse Events

Baseline characteristics were comparable between groups. The mean age was 58.2 ± 8.1 years (PRP) vs. 57.6 ± 7.9 years (control, p = 0.72), with similar gender distribution (M/F: 18/22 vs. 20/20, p = 0.63) and BMI (27.5 ± 3.2 vs. 28.1 ± 3.5 kg/m², p = 0.45). KL grading and OA duration were also comparable (Grade II/III: 22/18 vs. 20/20; duration 4.1 ± 1.9 vs. 4.3 ± 2.1 years; p > 0.05).

Pain scores were comparable at baseline between the PRP and control groups (7.2 ± 1.1 vs. 7.1 ± 1.2; p = 0.78). At 1 month, the PRP group showed a significant reduction compared to controls (5.1 ± 1.2 vs. 6.3 ± 1.3; p = 0.003), which further improved at 3 months (3.8 ± 1.0 vs. 5.9 ± 1.2; p < 0.001) and 6 months (3.2 ± 0.9 vs. 5.5 ± 1.1; p < 0.001).

Functional scores were similar at baseline between the PRP and control groups (55.4 ± 8.6 vs. 54.8 ± 9.1; p = 0.73). The PRP group showed a significant improvement over controls at 1 month (42.1 ± 7.8 vs. 50.3 ± 8.2; p = 0.001), which continued at 3 months (33.2 ± 6.5 vs. 48.7 ± 7.5; p < 0.001) and 6 months (28.5 ± 5.9 vs. 46.2 ± 7.1; p < 0.001).

Range of motion was comparable at baseline between the PRP and control groups (110.5 ± 8.2° vs. 111.2 ± 7.9°; p = 0.65). The PRP group showed a significant improvement over controls at 1 month (118.4 ± 7.5° vs. 114.3 ± 8.1°; p = 0.02), which further increased at 3 months (124.7 ± 6.8° vs. 116.5 ± 7.6°; p < 0.001) and 6 months (128.2 ± 6.3° vs. 117.8 ± 7.2°; p < 0.001).

Adverse events were mild and comparable between groups. Injection site pain occurred in 6 patients (15%) in the PRP group versus 2 (5%) in controls (p = 0.14), and swelling was reported in 4 (10%) versus 1 (2.5%) patient (p = 0.17). No infections were observed in either group. Joint stiffness was noted in 2 patients (5%) in the PRP group compared to 5 (12.5%) in controls (p = 0.24). Overall, 12 patients (30%) in the PRP group and 8 (20%) in the control group experienced adverse events (p = 0.28).

Discussion

In the present study, the majority of patients were middle-aged, with a mean age of 58.2 ± 8.1 years in the PRP group and 57.6 ± 7.9 years in the control group, and a slightly higher proportion of females in both groups. This demographic pattern is consistent with prior reports showing higher prevalence of knee osteoarthritis in older adults, with no significant gender bias [11,12]. Baseline characteristics, including BMI, KL grade, and duration of OA, were comparable between groups, supporting the validity of comparative outcome analysis.

Regarding pain, the PRP group showed significant improvement compared to controls, with VAS scores decreasing from 7.2 ± 1.1 at baseline to 3.2 ± 0.9 at 6 months, whereas the control group improved more modestly from 7.1 ± 1.2 to 5.5 ± 1.1 (p < 0.001). These findings align with studies by Shen et al. [13] and Bensa et al. [14], who reported that intra-articular PRP injections provide superior pain relief compared to saline or hyaluronic acid injections, particularly beyond the 3-month follow-up period.

Functional outcomes, assessed by WOMAC/functional scores, also favored the PRP group, with scores improving from 55.4 ± 8.6 at baseline to 28.5 ± 5.9 at 6 months, compared to 54.8 ± 9.1 to 46.2 ± 7.1 in controls (p < 0.001). These results are consistent with those of Filardo et al. [15] and Berrigan et al. [16], who noted that PRP enhances physical function and mobility in knee OA patients, with sustained benefits over 6–12 months.

Range of motion outcomes further corroborated these improvements, with the PRP group achieving significant gains in knee flexion (110.5 ± 8.2° at baseline to 128.2 ± 6.3° at 6 months) compared to controls (111.2 ± 7.9° to 117.8 ± 7.2°, $p < 0.001$). This is in agreement with the findings of Laudy et al. [17], indicating that PRP injections may improve joint mobility, likely through anti-inflammatory and regenerative mechanisms in the synovial tissue and cartilage.

Adverse events were mild and infrequent. Injection site pain occurred in 15% of patients in the PRP group versus 5% in controls, while swelling was reported in 10% versus 2.5%. No infections were reported, and overall adverse events were comparable (30% vs. 20%, $p = 0.28$). These results support the established safety profile of PRP therapy, as noted in prior studies [18,19,20], which reported only minor, self-limiting post-injection discomfort without serious complications. Overall, the study demonstrates that PRP injections provide significant and sustained improvement in pain, function, and joint mobility in knee OA, with a low incidence of adverse events.

Conclusion

In conclusion, intra-articular PRP injections in patients with knee osteoarthritis provide significant and sustained improvements in pain, functional outcomes, and range of motion compared to control treatment, with benefits evident from 1 month and persisting through 6 months. The therapy was well tolerated, with only mild and transient adverse events, and no serious complications were observed.

The efficacy and safety of PRP as a minimally invasive treatment option for knee OA, particularly for patients who have inadequate response to conventional conservative therapies, offering a promising alternative to delay or reduce the need for surgical intervention.

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