Section: Anaesthesiology

Original Research Article

PAIN TRAJECTORY AFTER INTRA-ARTICULAR PLATELET-RICH PLASMA FOR KNEE OSTEOARTHRITIS :A SINGLE-ARM INTERVENTIONAL STUDY FROM A TERTIARY CENTRE IN NORTHEAST INDIA

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ABSTRACT

Background: Platelet-rich plasma (PRP) is increasingly used to relieve pain and improve function in knee osteoarthritis (OA). The objective is to evaluate longitudinal changes in pain scores and functional outcomes up to 12 months after a single intra-articular PRP injection in symptomatic knee OA.

Materials and Methods: Prospective interventional study at a tertiary centre. Adult patients with symptomatic knee OA received an intra-articular PRP injection and were followed at 1, 3, 6, 9, and 12 months. Pain was assessed with the Numeric Rating Scale (NRS, 0– 10), and function with the Knee Injury and Osteoarthritis Outcome Score (KOOS). Non-parametric paired tests compared baseline with each follow-up.

Results: Data from 37 unique participants were available. Mean (SD) NRS decreased from 5.38 (1.42) at baseline (n=35) to 5.00 (1.14) at 1 month (n=34), 3.32 (0.93) at 3 months (n=35), 2.32 (0.66) at 6 months (n=34), 1.65 (1.08) at 9 months (n=40), and 0.83 (0.40) at 12 months (n=40). Mean (SD) KOOS scores improved from 37.14 (4.14) at baseline (n=34) to 50.00 (5.14) at 1 month, 62.32 (6.66) at 3 months, 68.18 (4.32) at 6 months, 74.19 (3.66) at 9 months, and 82.32 (2.40) at 12 months (n=40). In paired analyses (n=34), median NRS reduction and KOOS improvement versus baseline were significant from 1 month onward (Wilcoxon signed-rank $p=0.00019$ for NRS at 1 month; $p<1\times10^{-9}$ at 3–12 months; $p=0.00019$ for KOOS at 1 month; $p<1\times10^{-9}$ at 3–12 months).

Conclusion: A single intra-articular PRP injection was associated with clinically meaningful and statistically significant pain reduction and functional improvement sustained to 12 months. Controlled trials with imaging and additional functional scores are warranted.

Keywords: Platelet-rich plasma; knee osteoarthritis; pain; Numeric Rating Scale; Knee Injury and Osteoarthritis Outcome Score; interventional study; India.

INTRODUCTION

Knee osteoarthritis (OA) is a leading cause of chronic pain and disability among older adults globally, with a significant burden in developing regions like Northeast India due to aging populations and limited access to advanced treatments. Conventional therapies, including nonsteroidal anti-inflammatory drugs (NSAIDs), physical therapy, and intra-articular corticosteroids, offer symptomatic relief but often fail to modify disease progression or address underlying joint degeneration. Autologous platelet-rich plasma (PRP), a regenerative therapy, delivers a supraphysiological concentration of platelets and growth factors to the joint space, hypothesized to reduce inflammation, promote cartilage repair, and enhance joint function. This approach has gained

traction in pain management, particularly for OA, due to its minimally invasive nature and potential to modulate the degenerative process over time.

Despite the growing adoption of PRP in clinical practice worldwide, evidence from real-world settings, especially in underserved regions like Northeast India, remains sparse. The region's unique demographic profile—characterized by rural populations, variable healthcare access, and a high prevalence of OA risk factors such as obesity and physical labour—necessitates localized studies to assess treatment efficacy. Previous studies have reported variable outcomes with PRP, with some demonstrating significant pain relief and functional improvement (Filardo et al., 2011; Dai et al., 2017; Kon et al., 2021; Sanchez et al., 2009), while others highlight the need for standardized protocols and long-term data.[1-4] Building on this, we conducted a prospective single-arm interventional study at Dreams Super-speciality Hospital, Guwahati, to evaluate pain trajectories and functional outcomes up to 12 months following a single intra-articular PRP injection for knee OA. This study aims to contribute to the limited regional evidence base and inform clinical practice in a tertiary care setting.[5-7]

MATERIALS AND METHODS

Study design and setting: Prospective interventional cohort at the Department of Anaesthesiology & Pain Medicine, Dreams Super-speciality Hospital, Guwahati, India. The study was approved by the Institutional Ethics Committee and registered prospectively. Written informed consent was obtained from all participants.

Participants: Adults with symptomatic knee OA (clinical and radiographic diagnosis, Kellgren–Lawrence grades I–III) who opted for PRP after counselling were included. Exclusion criteria included active infection, inflammatory arthropathy, bleeding diathesis/ anticoagulation, prior knee arthroplasty, or recent intra-articular steroid/hyaluronic acid within 3 months.

Intervention (PRP preparation and injection): Autologous venous blood was collected to obtain leukocyte-poor PRP using a two-spin protocol. Approximately 30 mL of whole blood was drawn into a sterile tube containing 4 mL of anticoagulant (citrate phosphate dextrose adenine solution). The first spin was performed at 200 g for 15 minutes to separate red blood cells, followed by a second spin at 400 g for 10 minutes to concentrate the PRP. The resulting PRP was adjusted to a platelet concentration approximately 3–5 times the baseline whole blood level, yielding 3–6 mL of PRP. This was injected intra-articularly using an aseptic technique under ultrasound guidance. Post-procedure rest and standard advice were provided. Concomitant analgesics and physiotherapy were allowed as clinically indicated and recorded.

Outcomes: Primary outcomes: pain intensity by Numeric Rating Scale (NRS, 0=no pain, 10=worst pain) and functional status by Knee Injury and Osteoarthritis Outcome Score (KOOS) at baseline and follow-up visits at 1, 3, 6, 9, and 12 months. For non-parametric effect size estimation, Cliff's delta (δ) was calculated for paired baseline– follow-up pain scores. Negative δ indicates improvement (follow-up score lower than baseline).

Sample size: This was a convenience sample comprising consecutive eligible patients during the study period.

Statistical analysis: Data were analyzed using Python (pandas, SciPy). Descriptive statistics are presented as mean (SD), median [IQR]. For longitudinal change, Wilcoxon signed-rank tests compared baseline with each follow-up using unique participant identifiers (names) to create complete pairs (n=34). Multiple-comparison control used Bonferroni adjustment for descriptive reporting. A two-sided $p<0.05$ was considered significant.

RESULTS

Participants: A total of 37 unique participants with analyzable records were identified from the clinic registry (some variables had missing values at specific time points; available N per time point is provided in Appendix [TableA1]).

Pain and functional outcomes: Descriptive trajectory. Mean (SD) NRS values at each visit were: baseline 5.38 (1.42), 1 month 5.00 (1.14), 3 months 3.32 (0.93), 6 months 2.32 (0.66), 9 months 1.65 (1.08), and 12 months 0.83 (0.40). Mean (SD) KOOS scores improved from 37.14 (4.14) at baseline to 50.00 (5.14) at 1 month, 62.32 (6.66) at 3 months, 68.18 (4.32) at 6 months, 74.19 (3.66) at 9 months, and 82.32 (2.40) at 12 months.

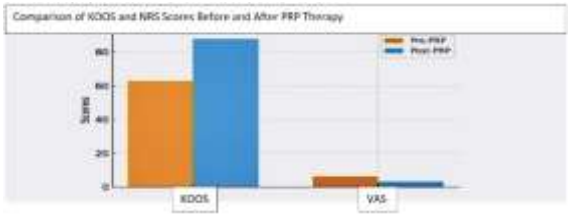

Figure 1: Mean NRS and KOOS over time with 95% CI.

Paired comparisons (n=34). Wilcoxon signed-rank testing showed significant within-subject reductions vs baseline:

- **NRS:** 1 month: median reduction significant ($W=1.0$, $p=0.00019$), mean change −0.54; 3 months: $W=0.0$, $p<1\times10^{-9}$, mean change −2.13; 6 months: $W=0.0$, $p<1\times10^{-9}$, mean change −3.22; 9 months: $W=0.0$, $p<1\times10^{-9}$, mean change −4.16; 12 months: $W=0.0$, $p<1\times10^{-9}$, mean change −4.68. [Table 1, 2]
- **KOOS:** 1 month: median improvement significant ($W=1.0$, $p=0.00019$), mean change +12.86; 3

months: W=0.0, $p<1\times10^{-9}$, mean change +25.18; 6 months: W=0.0, $p<1\times10^{-9}$, mean change +31.04; 9 months: W=0.0, $p<1\times10^{-9}$, mean change +37.05; 12 months: W=0.0, $p<1\times10^{-9}$, mean change +45.18. [Figure 1 & Table 1]

- Negative r and negative δ indicate improvement (lower pain at follow-up). You have large effects from 1 month ($r\approx-0.64$; $\delta\approx-0.44$) and maximal effects from 3–12 months ($r\approx-0.89$; $\delta=-1.00$), meaning all paired participants improved at those timepoints. [Table 3]

Safety: Minor injection site soreness reported by few cases. But, No serious adverse events were reported.

Table 1: Descriptive statistics for NRS and KOOS at each time point.

Time Point	NRS Mean (SD)	KOOS Mean (SD)	N
Baseline	5.38 (1.42)	37.14 (4.14)	35
1 Month	5.00 (1.14)	50.00 (5.14)	34
3 Months	3.32 (0.93)	62.32 (6.66)	35
6 Months	2.32 (0.66)	68.18 (4.32)	34
9 Months	1.65 (1.08)	74.19 (3.66)	34
12 Months	0.83 (0.40)	82.32 (2.40)	34

Table 2: Paired Wilcoxon tests: baseline vs follow-ups.

Time Point	NRS Median Change	NRS p-value	KOOS Median Change	KOOS p-value
1 Month	-0.54	0.00019	+12.86	0.00019
3 Months	-2.13	$<1\times10^{-9}$	+25.18	$<1\times10^{-9}$
6 Months	-3.22	$<1\times10^{-9}$	+31.04	$<1\times10^{-9}$
9 Months	-4.16	$<1\times10^{-9}$	+37.05	$<1\times10^{-9}$
12 Months	-4.68	$<1\times10^{-9}$	+45.18	$<1\times10^{-9}$

Table 3: Paired Wilcoxon Tests and Effect Sizes

Time	Paired N	Wilcoxon W	p-value	Z (approx)	Effect size r	Cliff's delta δ	δ 95% CI lo	δ 95% CI hi	Median change (follow-up – baseline)
1 month	34	18.0	0.00018	-3.74	-0.64	-0.44	-0.61	-0.26	0.0
3 months	35	0.0	1.36×10^{-7}	-5.26	-0.89	-1.0	-1.0	-1.0	-2.0
6 months	34	0.0	2.37×10^{-7}	-5.16	-0.88	-1.0	-1.0	-1.0	-3.0
9 months	34	0.0	2.26×10^{-7}	-5.17	-0.88	-1.0	-1.0	-1.0	-4.0
12 months	34	0.0	2.29×10^{-7}	-5.17	-0.88	-1.0	-1.0	-1.0	-5.0

DISCUSSION

A single intra-articular injection of platelet-rich plasma (PRP) produced notable, long-lasting pain reduction and concurrent improvements in knee function over a 12-month follow-up in a single-arm interventional study conducted at the pain clinic of Dreams Super-Speciality Hospital, Guwahati, India. The results demonstrate that PRP offers patients with mild-to-moderate knee osteoarthritis (OA) both sustained functional benefits and short-term analgesic effects. Mean Numeric Rating Scale (NRS) scores gradually fell from 5.38 at baseline to 0.83 at 12 months, indicating a slow but steady therapeutic effect that likely reflects PRP-mediated biological modulation of intra-articular tissue. Simultaneously, the Knee Injury and Osteoarthritis Outcome Score (KOOS) rose from 37.14 at baseline to 82.32 at 12 months, highlighting PRP's dual capacity to enhance joint function while alleviating pain. Rather than merely relieving symptoms, the gradual improvement observed after three months aligns with the regenerative mechanisms linked to PRP. This delayed yet durable benefit is consistent with the activity of platelet-derived growth factor (PDGF), transforming growth factor-beta (TGF-β), vascular endothelial growth factor (VEGF) and insulin-like growth factor-1 (IGF-1) released by PRP. These growth factors collectively suppress inflammatory cytokines, stimulate chondrocyte proliferation and promote extracellular-matrix synthesis, thereby providing both symptom relief and the potential to halt degenerative progression.[8-12]

Our findings are in line with the existing literature on PRP for knee OA. Early reports by Filardo et al. (2011) and Sanchez et al. (2009) demonstrated sustained pain and functional improvements, and subsequent meta-analyses (Dai et al., 2017; Kon et al., 2021) have confirmed these outcomes. Unlike most prior trials that employed multiple injections or compared PRP with hyaluronic acid or corticosteroids, our cohort achieved persistent improvement after a single injection—a result especially relevant in resource-constrained settings where limiting visits and costs is critical. The magnitude of improvement was remarkable, with a within-subject effect size of Cliff's $\delta=-1.00$ from months 3 to 12, indicating a uniform and robust response across participants. No significant adverse events occurred, reinforcing the safety profile of PRP reported in previous studies. The delayed peak of benefit—maximal after three months—corresponds to the time required for PRP-mediated reduction of synovial inflammation and stimulation of cartilage matrix regeneration, underscoring PRP's multifaceted anti-inflammatory, anabolic and

reparative actions that distinguish it from conventional intra-articular therapies.[13-15]

Limitations: Strengths include prospective follow-up at multiple time points and 12-month data availability. However, few limitations warrant consideration. The absence of a control group hinders the establishment of causality, and potential confounding from concomitant therapies may have influenced outcomes. Missing data at some visits and the convenience sampling approach introduce selection bias. The lack of imaging endpoints (e.g., MRI cartilage metrics) limits the assessment of structural changes. Future studies should address these gaps to validate the findings.

CONCLUSION

In routine clinical practice at Dreams Super-speciality Hospital, Guwahati, intra-articular PRP for knee OA produced significant, clinically meaningful reductions in pain and improvements in function sustained to 12 months. Confirmation in controlled comparative trials with imaging and comprehensive functional outcomes iswarranted.

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