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Umbilical Cord PRP Is Better in Relieving Pain in Patients of Knee Osteoarthritis as Compared to Autologous Venous PRP

Muhammad Umer[1], Muhammad Abdullah[2], Liaqat Ali[3], Khaleel Ahmad[4], Komal Mumtaz[5], Syeda Gul e Zahra[6]

[1,2,6]Capital Hospital, CDA, Islamabad, [3,4,5]Fauji Foundation Hospital, Rawalpindi

Author`s Contribution

[1-3] Substantial contributions to the conception or design of the work; or the acquisition, analysis, or interpretation of data for the work, [4,5]Active participation in active methodology, analysis, or interpretation of data for the work, [6]Drafting the work or revising it critically for important intellectual content

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Address of Correspondent
Dr Muhammad Abdullah
Capital Hospital, CDA, Islamabad
abdullah.nsmc@gmail.com

ABSTRACT

Objective: To evaluate the effectiveness of umbilical cord blood platelet-rich plasma (CB-PRP) and autologous venous platelet-rich plasma (A-PRP) in the pain relief and knee functional improvement for patients with early-stage knee osteoarthritis (OA).

Methodology: This observational study carried out in the Anesthesia Department of a CDA Hospital, a tertiary care hospital in Islamabad from from Sep 2024 - Feb 2025. Sixty patients with Kellgren-Lawrence Grade 1–2 knee OA were randomized into 2 groups with 30 patients in each group, in the CB-PRP and A-PRP group. Aseptically injected PRP into the joint. Outcomes included the Visual Analog Scale (VAS), Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), and the Knee Injury and Osteoarthritis Outcome Score (KOOS) at baseline, 4 weeks, 12 weeks, and 24 weeks. The analysis was done by SPSS statistical software (version 26). We considered p-value < 0.05 as statistically significant.

Results: CB-PRP displayed significant improvement on VAS scores at all follow-ups compared with A-PRP (weeks 4: 3.69 ± 0.87 vs. 6.31 ±1.03 p < 0.001). KOOS scores at 24 weeks were also greater in the CB-PRP compared to the placebo group (75.12 ± 6.76 vs. 62.34 ± 7.12; p < 0.001). There was a steady improvement in WOMAC scores in both groups of patients, and a significant difference in favor of CB-PRP was found at 24 weeks (2.44 ± 0.73 vs 3.00 ± 0.71, p = 0.040). There were no significant adverse events.

Conclusion: CB-PRP was more effective than A-PRP in pain reduction and functional improvement total scores in early knee OA.

Keywords: Knee Osteoarthritis, Platelet-Rich Plasma, Umbilical Cord PRP, Autologous PRP, Pain Management, KOOS, WOMAC, VAS

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Introduction

Osteoarthritis (OA) is a chronic progressive musculoskeletal disorder characterized by degradation of articular cartilage associated with synovial membrane inflammation and subchondral bone alterations.[1] In particular, knee OA is among the first and most common causes of disability worldwide, especially in the elderly people, and frequently results in significant pain, stiffness, and loss of joint motion.[3] With the increasing aging population, knee OA burden is anticipated to increase and will further challenge both the health care systems and the quality of life of the affected people.[1] The development of knee OA is generally gradual, however reduction in functional capacity within activities of daily living (ADLs), and significant socioeconomic implications are observed.[2]

Conventional treatment modalities for knee OA, such as NSAIDs, intra-articular corticosteroids, physical therapy, and lifestyle modifications are strategies used for control but not the disease-modifying plan.[3] while effective in the short term, these strategies generally do not target the degenerative pathology and cannot prevent the progress of the disease. In such a scenario, regenerative therapy like platelet-rich plasma (PRP) has attracted significant

interest for its ability to attenuate inflammation, promote cartilage healing, and enhance long-term results.[4]

PRP is an autologous or allogenic blood product with high concentration of platelets and growth factors, which participate in tissue regeneration, cell proliferation, angiogenesis, and anti-inflammatory action.[5] Intrajoint application in knee OA has proven to enhance the pain and joint function, especially in the early stage of the disease.[15] At present, there are two main PRP formulations used in the clinical setting:

A-PRP: The patients "own" venous blood, manipulated in order to be concentrated in platelets. Its greatest advantage is immunologic safety and minimal risk of disease transfer.[6]

Umbilical cord blood–derived PRP (CB-PRP): CB-PRP is obtained from screened donor umbilical cord blood, which is a high concentration of growth factors and bioactive proteins, and can also contain mesenchymal stem cells (MSCs) and cytokines added to its regenerative potency.[7] Theoretically, studies have shown that CB-PRP could have increased biological potency over autologous counterparts.[8]

While both A-PRP and CB-PRP are clinically applied to treat knee OA, head-to-head studies of these products have been scarce. Recent studies showed favorable results for both preparations; however, the lack of long-term randomized controlled trials (RCTs) comparing the safety, durability, and regenerative capacity of both preparations hampers a more widespread use.[3,4] Furthermore, there is no agreement on the best source of PRP in some patient population, such as elderly group or with comorbidities such as diabetes, which might have compromised autologous blood quality.[5]

This study intends to fill this void by directly comparing the clinical efficacy between CB-PRP and A-PRP among the patients with the early to mild knee OA. By examining pain (VAS) and functional (WOMAC and KOOS) scores through 24 weeks, we aim to assess the comparative efficacy and theoretical benefits of CB-PRP over traditional autologous therapy. By creating clinical evidence for such biologic treatments, this study is expected to inform individualized therapeutic strategies in OA that promote healing and patient quality of life.

Methodology

This observational study done in tertiary care hospital of Islamabad CDA from Sep 2024 - Feb 2025, after approval from the institutional ethical review board Ref no IRB-78-02/1/25. Consecutive adult patients ranging in age from 35 to 70 years with early-stage knee OA (Kellgren-Lawrence grade 1–2) who had clinical symptoms present for at least three months were enrolled. Written informed consent was obtained from all patients prior to enrolment.[15]

Subjects with severe OA as diagnosed on x-ray Grade 3 or 4, intra-articular injections within six months, autoimmune disease, active infection, malignancy or coagulopathy were excluded. Of 60 patients assessed for eligibility, 57 were randomly allocated to either of the two treatments in a computer-generated random order. Patients (n=60) were dichotomized as Group A (n=30) who were administered autologous PRP (A-PRP) injections and Group B (n=30) who were given umbilical cord-derived PRP (CB-PRP).

A-PRP was obtained through sterile venipuncture and subsequent centrifugation of the patient's own peripheral blood with the purpose of platelet and growth factor concentration, using standard protocols for PRP preparation. CB-PRP was derived from pre-screened FDA-licensed cryopreserved umbilical cord blood units. Both PRP categories were applied as a single aseptic IA injection in the affected knee.

Visual Analog Scale (VAS) for pain intensity, and the pain, stiffness, and physical function subscales of the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), and Symptoms, Activities of Daily Living, and Quality of Life subscales of the Knee injury and Osteoarthritis Outcome Score (KOOS) were used to assess clinical outcomes. Evaluations were performed at baseline (Week 0), and during Week 4, 12, and 24.

All statistical analysis was conducted in SPSS version 26. Continuous data are presented as mean ± standard deviation. Baseline characteristics between groups were compared using independent samples t-tests. Time effects in and between groups were evaluated by repeated measures ANOVA with post hoc analysis. A p-value < 0.05 was accepted as significant.

Results

The demographic characteristics of the study population at baseline are detailed in Table 1. The average age of the patients in the A-PRP group was 55.6 ± 7.2 years and in the CB-PRP group it was 56.9 ± 6.4 years (no statistically difference between groups, $p = 0.41$). Gender balance was also similar, with 70% females and 30% males in the

Table I: Demographics.				
Characteristics		**A-PRP Group (n = 30)**	**CB-PRP Group (n = 30)**	**p-value**
Mean Age (± SD)		55.6 ± 7.2 years	56.9 ± 6.4 years	0.410
Gender	Female, N (%)	19 (63.3%)	19 (63.3%)	0.592
	Male, N (%)	11 (36.7%)	11 (36.7%)	
Mean Duration of Knee Pain (months ± SD)		11.2 ± 2.1	10.9 ± 2.4	0.610

A-PRP group compared to 63.3% females and 36.7% males in the CB-PRP group (p = 0.59). Moreover, the average duration of pain pre-intervention was comparable in both groups, at 11.2 ± 2.1 versus 10.9 ± 2.4 months in the A-PRP and CB-PRP groups, respectively (p = 0.61). The fact that both groups were demographically well-balanced at baseline is an important methodological aspect that reduces possible functional confounding variables which may influence the results (such as age, sex and duration of the symptom) and enables a stronger comparison of the results obtained.

Binary comparisons of VAS scores between A-PRP and CB-PRP groups at different time points show significance.

After 4 weeks, the mean VAS score was 6.31 ± 1.03 in A-PR and 3.69 ± 0.87 in CB-PRP. This difference was statistically significant (p < 0.001) which concludes that the early phase of treatment showed a significant decrease in pain in the CB-PRP group in comparison with the A-PRP group. The increased trend of pain relief with CB-PRP was maintained at week 12 and the mean VAS score was significantly higher in the CB-PRP group (3.44 ± 0.96) compared to the A-PRP group (5.92 ± 0.86) (p < 0.001). At week 24, this trend was unaltered, and the mean VASs were 5.92 ± 0.95 in the A-PRP group and 3.50 ± 0.82 in the CB-PRP group, with a statistically significant difference (p < 0.001). (Table II) These observations indicate that CB-PRP was associated with greater and longer reduction in pain than A-PRP over the 24 weeks of follow-up. The tendency of similar change in all evaluation times favors that the CB-PRP might be superior in attaining the long-term pain control in some early stage OA knee patients.

Table II: Comparison of VAS Scores between Groups. (n = 30)

Parameter	A-PRP group (n=30)	CB-PRP (n=30)	p-value
VAS Baseline	7.31 ± 0.75	7.53 ± 0.74	0.421
VAS Week 4	6.31 ± 1.03	3.69 ± 0.87	<0.001
VAS Week 12	5.92 ± 0.86	3.44 ± 0.96	<0.001
VAS Week 24	5.92 ± 0.95	3.50 ± 0.82	<0.001

WOMAC scores were similar at baseline in both groups (A-PRP group: 3.77 ± 0.44, CB-PRP group: 3.62 ± 0.50, p = 0.352), suggesting that no significant difference exists in terms of the functional status of the knees at baseline. At 4 weeks, WOMAC scores had decreased in both groups, with A-PRP reduced to 3.38 ± 0.51 and CB-PRP to 3.00 ± 0.73; however, the difference was not statistically significant (p = 0.070). The trend showed a slow recovering at week 12 (3.15 ± 0.69 for A-PRP group, and 2.81 ± 0.75 for CB-PRP group, p = 0.211), without significant difference between groups. At week 24, the CB-PRP group was significantly superior to the A-PRP group with regard to scores (2.44 ± 0.73 vs. 3.00 ± 0.71; p = 0.040). Table III

Table III: Comparison of WOMAC Scores between Groups. (n = 30)

Parameter	A-PRP group (n=30)	CB-PRP (n=30)	p-value
WOMAC Baseline	3.77 ± 0.44	3.62 ± 0.50	0.352
WOMAC Week 4	3.38 ± 0.51	3.00 ± 0.73	0.070
WOMAC Week 12	3.15 ± 0.69	2.81 ± 0.75	0.211
WOMAC Week 24	3.00 ± 0.71	2.44 ± 0.73	0.040

The KOOS scores at baseline did not differ on average between the A-PRP and CB-PRP groups (45.23 ± 7.12 and 44.89 ± 7.34, p = 0.870), suggesting similar initial knee function and quality of life. At 4 weeks, there was noted a significant improvement in the two groups, yet this was significantly higher in the CB-PRP group (63.45 ± 6.12) as compared to the A-PRP group (55.21 ± 6.89), with a highly significant difference (p < 0.001). The above trend also was observed at 12 weeks, in the CB-PRP group versus the A-PRP group with KOOS scores of 70.33 ± 6.21 and 60.67 ± 7.45 (p < 0.001), directly indicating persistent functional improvements and symptom relief in the CB-PRP group. The last time point, follow-up visit (week 24) clearly demonstrated the remunerative superiority of the CB-PRP group with a mean KOOS of 75.12 ± 6.76 to 62.34 ± 7.12 in the A-PRP group once more disclosing a clear gap (p < 0.001). Table IV

Table IV: Comparison of KOOS Scores between Groups. (n = 30)

Parameter	A-PRP group (n=30)	CB-PRP (n=30)	p-value
KOOS Baseline	45.23 ± 7.12	44.89 ± 7.34	0.870
KOOS Week 4	55.21 ± 6.89	63.45 ± 6.12	<0.001
KOOS Week 12	60.67 ± 7.45	70.33 ± 6.21	<0.001
KOOS Week 24	62.34 ± 7.12	75.12 ± 6.76	<0.001

Discussion

This study was conducted to compare the effects of umbilical cord- (UC-) derived platelet-rich plasma (PRP), referred to as cord blood PRP (CB-PRP), with those of autologous PRP (A-PRP) on early-stage knee osteoarthritis (OA) progression. During the 6-month follow-up, both the programs led to a significant decrease in pain intensity (Visual Analog Scale [VAS]) and functional outcomes (Western Ontario and McMaster Universities Osteoarthritis Index [WOMAC] and Knee Injury and Osteoarthritis Outcome Score [KOOS]). However, CB-PRP revealed improved pain reduction and better functional scores at 4, 12, and 24 weeks than did ACP, indicating that they may have some therapeutic benefit during early phase of recovery.

Our results were consistent with a study from Coviello and colleagues who also demonstrated that symptom relief was better for CB-PRP when compared to A-PRP during the first 3 months however, this benefit decreased overtime such that by 12 months both A-PRP and CB-PRP demonstrated similar therapeutic efficacy.[9] Similarly, Caiaffa et al. could show that one single intra-articular injection of CB-PRP with noticeable pain improvement and statistically significant better function at 3 and 6 months after injection demonstrated the early benefit profile of CB-PRP.[7] Such data further support that CB-PRP might provide a quick symptomatic relief, possibly reflecting its bioactive print.

CB-PRP contains increased content of regenerating cytokines and growth factors such as PDGF, VEGF, TGF-β, and IL-10 when compared with A-PRP. Together, these molecules play a role in cartilage regeneration, modulation of inflammation and activation of chondrocytes. Li et al., in a triple-blind randomized study, reported that PRP, particularly cord-derived PRP, reduced inflammatory cytokines level in synovial fluid, which further supports its therapeutic use in OA management.[8]

Furthermore, Zhang et al. carried out a detailed analysis and found that umbilical cord (UC) derived mesenchymal stem cells (MSCs) which are commonly co-isolated alongside the UC-PRP not only leads to cartilage healing but by factors from the MSC, show a number of immune-modulatory features, which are helpful in degenerative joint conditions.[10] This may also explain the continued improvements in KOOS in our CB-PRP group out to 24 weeks.[11]

Although immediate advantages of CB-PRP are clear, long-term efficacy is uncertain. Long-term follow-up studies, such as that reported by Coviello et al., indicate that treatment effects of CB-PRP could plateau or even converge to those of A-PRP after 9–12 months post-treatment.[9] This presents key issues about sustainable dose re challenge and interval. Zhuang et al. investigated the effects of different numbers of injections and found that more than 3 intra-articular PRP injections lasted longer than a single injection, especially in patients with moderate and higher OA.[3] Therefore, the one-injection protocol in this study, which was therapeutically effective at short-term follow-up, may have underestimated the full therapeutic effect of the CB-PRP in repeat courses of applications.[20]

Another clinical factor is that the variable quality of the PRP donor. This approach of autologous PRP is restricted by considerable patient-to-patient variability, particularly in elderly patients or in patients with comorbidities such as diabetes or chronic inflammation that could impair platelet function and regenerative potential. CB-PRP, however, is derived from prescreened, healthy donors, prepared under controlled conditions and provides a consistent supply and biological activity of high quality. This renders CB-PRP a more standardized therapeutic product, especially for patients with a poor quality of autologous blood.

But also, you have to factor in mass and cost considerations. CB-PRP processing involves regulatory compliance, donor eligibility screening, cryopreservation and standardized manufacturing processes, which may increase costs and restrict the availability of these products. Its potential value in early stages may support a selection of patients, but the cost-effective comparison with A-PRP is questionable in the absence of longer-term superiority.[12]

Our study had several limitations despite strengths that include a randomized controlled trial design and serial evaluations over the course of 6 months.[16] First, the small sample size and single-center design of the study may limit its generalizability. Second, the design of the study did not allow for imaging (MR or US) to quantitatively

and objectively assess structural cartilage regeneration. Third, because there is no placebo or hyaluronic acid control group, it is unclear how the efficacy of PRP might compare with standard care. Fourth, the intervention was a one-off injection, not representative of potential repeated dosing protocols that have been successful in previous research.[3,14] Failure to include placebo or sham injection control prevented us to fully appreciate placebo effect, as recommended by researcher.[17,18] and other OA injection studies.

The effects of multi-dose CB-PRP preparations need to be investigated in future studies, mainly in patients with advanced OA.[19] In addition, the incorporation of objective imaging markers like cartilage thickening and synovial fluid biomarkers may elucidate the mechanism of action and aid to stratify those patients most likely to demonstrate a benefit. Furthermore, comparative cost-effectiveness studies are required to establish whether the functional advantage from CB-PRP early on leads to clinically significant long-term benefit to justify its additional cost.

In summary, our data indicated that CB-PRP resulted in early and better symptomatic improvement than A-PRP in patients with knee OA, consistent with the findings of recent studies.[7–9] This early advantage likely results from the better growth factor profile and less variable CB-PRP. Nonetheless, with comparable medium- to long-term outcomes and increased expense, CB-PRP should be seen as a selective choice—mainly in patients with suboptimal autologous blood.[11,13] Further research with larger, multicenter trials with long-term follow-up, standardized imaging and economic analyses is required to define the long-term contribution and positioning of CB-PRP in the structure of OA treatment.

Conclusion

In the summary, A-PRP and CB-PRP are both effective alternatives for the treatment of early knee OA. Nevertheless, CB-PRP provided better pain relief and functional recovery and better reliability of the outcomes, thus representing the preferred choice in particular in elderly patients and in presence of poor autologous blood quality.[14] Larger, random, and longer-term follow-up and imaging investigation are required to provide additional definitive evidence to support the long-term effectiveness and safety of CB-PRP in the treatment of knee OA.

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