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# Evaluating The Impact Of Patient's Platelet Indices On The Platelet Yield Of Platelet Rich Plasma Preparation And Its Effect On The Clinical Outcome In Patients With Osteoarthritis- A Prospective Study

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**ABSTRACT**

**Introduction:** Platelet-rich plasma (PRP) is defined as a volume of autologous plasma with a platelet concentration higher than the average in peripheral blood. Many trials report that PRP can be used to improve musculoskeletal conditions including osteoarthritis. The correlation between platelet count and clinical response remains uncertain. This study primarily examines platelet count and its indices such as mean platelet volume (MPV), plateletcrit (PCT) and platelet distribution width (PDW) to ascertain their significance in PRP treatment.

**Methods:** PRP was prepared using the BIOPRO PRP kit by Alchem Diagnostics and was administered as an intraarticular injection. Total platelet count, MPV, PCT and PDW of the patient and PRP prepared were measured. The clinical outcomes of the patients were assessed using the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) and Visual Analog Scale (VAS) grading, before and 6 weeks after the PRP injection

**Results:** The mean age of patients was 48.15±7.02 years and there were 10 (50%) females and 10 (50%) males. An increase in platelet count, MPV and PCT in PRP prepared by double spin method showed improvement in VAS (Before-7.4 ± 0.75; After-4.15 ± 1.18) and WOMAC (Before-74.6 ± 10.98; After-52.85 ± 8.6) were found to be statistically significant. Most of the platelet parameters have a positive correlation with the clinical outcome however it is not statistically significant

**Conclusion:** Intra-articular injection of PRP in OA knee is an efficient and cost-effective treatment. A platelet count of more than 10,000 cells/µL in PRP is sufficient for pain relief

**Keywords:** platelet rich plasma, correlation, clinical outcome, platelet parameters, osteoarthritis.

## INTRODUCTION

Platelet rich plasma (PRP) concentrates platelets within a small volume of autologous plasma.Historically, platelets were primarily regarded as hemostatic agents. However,

subsequent research by scientists revealed their proliferative capabilities. It was in the late 1990s, following the discovery of growth factors that the concept of utilizing platelet concentrates for non-hemostatic therapy emerged [1]. PRP therapy is being used in orthopedics, maxillofacial surgery, regenerative medicine, and dermatology. PRP includes various growth factors like platelet-derived growth factors (PDGF), transforming growth factor (TGF), insulin-like growth factor (IGF), vascular endothelial growth factors (VEGFs), epidermal growth factor (EGFs) and Fibroblast growth factor (FGF) [2].PRP also contains Leukocytes in a different concentration according to the method of preparation [3].

Osteoarthritis (OA) is a degenerative joint disease resulting from the degradation of articular cartilage, accompanied by degradation and proliferative reformation of subchondral bone and a low degree of synovitis that leads to a reduced quality of life [4]. Strategies to manage OA of the knee include functional improvement, reduction in disability, pain relief, and hence improved quality of life [5, 6].Non-operative therapeutic interventions like intra-articular injection at the knee joint, including corticosteroids, hyaluronic acid (HA), non-steroidal anti-inflammatory drugs (NSAIDs), platelet-rich plasma (PRP), and physiotherapy also play a major role in the management of knee OA [7].A study by Patel et al. focusing on patients in early-stage of osteoarthritis (OA) of the knee revealed that platelet-rich plasma (PRP) demonstrated greater efficacy compared to a placebo in reducing pain, and stiffness and improving knee functioning in the short term [8].

Numerous studies have highlighted the importance of assessing complete blood count (CBC) including platelet count, at least three months before initiating PRP therapy. This allows for the evaluation of circulating platelets and the identification of any absolute contraindications [9, 10]. However, the correlation between platelet count and clinical response remains uncertain [9, 11]. Therefore, this study primarily examines platelet count and its indices such as mean platelet volume (MPV), plateletcrit (PCT), and platelet distribution width (PDW) to ascertain their significance in PRP treatment.

## METHODOLOGY

Thisis a prospective study done in the Department of Transfusion Medicine at Saveetha Medical College and Hospital, Chennai. All patients who were diagnosed with symptomatic osteoarthritis of the knee and who had little or no pain relief after conservative treatment were included in the study. Patients with history of knee surgery, significant joint swelling, or clinical signs of acute inflammation, septicemia, local knee infection, and patients with known platelet/ bleeding disorders were excluded from the study. During the study period, about 20 patients who had consented to PRP therapy were included in the study.

PRP was prepared using the BIOPRO PRP kit by Alchem Diagnostics. At every sitting, 16 ml of autologous whole blood was collected in two tubes 8 ml each from the patients, and mixed with acid citrate dextrose (ACD) anticoagulant, and kept at rest for 5min. 2 ml of whole blood was collected separately in an ethylene diamine tetra acetic acid (EDTA) tube to assess platelet parameters. Both the 8ml tubes were centrifuged at 2500 rpm for 5 minutes to separate the RBC from the plasma. Plasma from both the tubes was transferred into a harvest tube & centrifuged at 3800 rpm for 12 minutes. The supernatant Platelet poor plasma was removed & the bottom 3ml plasma was mixed to get a homogeneous mixture of PRP. 5 drops of pH regulator and 100

microliters of PRP activator was added to the final PRP product, which was used for application. (Figure 1) Total platelet count, mean platelet volume (MPV), plateletcrit (PCT), and platelet distribution width (PDW) of the patient and PRP prepared were measured using an automated analyzer.

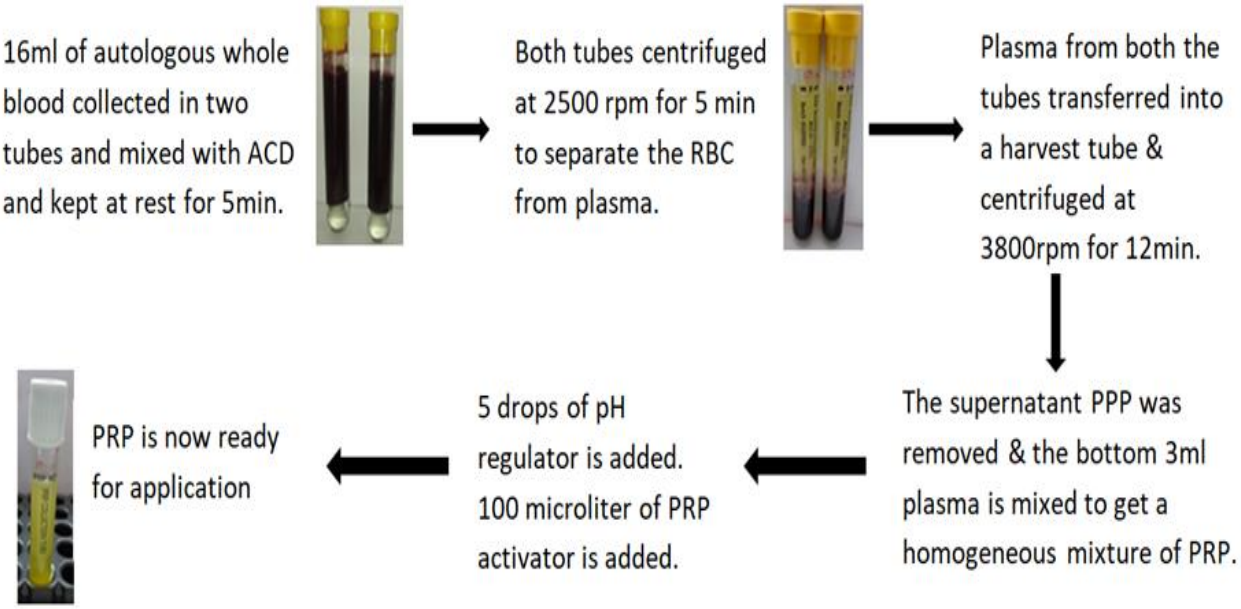


Figure 1: method of PRP preparation

Under sterile aseptic precaution, the collected PRP was injected into the intraarticular space by the orthopedician. The clinical outcome of the patients was assessed using the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) and Visual Analog Scale (VAS) grading [12, 13]. The clinical parameters as per the assessment tool of the patient were recorded before and 6 weeks post PRP injection.

The statistical analysis was done by paired t-test and Pearson's correlation test using IBM SPSS version 27.0

**RESULTS**

Out of 20 patients included in the study, 10 (50%) were males and 10 (50%) were females. The mean age of the patients was 48.15±7.02 years. (Table 1)

Table 1: age and sex distribution

| Age (years) | Male | Female |
|---|---|---|
| 30-40 | 1 | 2 |
| 41-50 | 4 | 4 |
| 51-60 | 5 | 4 |
| Total | 10 | 10 |

The mean platelet count in the PRP was found to be 1016.5 ± 60.14 x $10^3$ cells/μL. There was a positive correlation between the patient's platelet count and platelet count in the PRP, however, it was not statistically significant. There was a significant correlation among other parameters like MPV, PCT, and PDW. (Table 2)

Table 2: Correlation between patient and PRP platelet parameters

| Variables | Patient (mean ± SD) | PRP (mean ± SD) | R value | P value |
|---|---|---|---|---|
| Platelet count (x$10^3$/ μL) | 282.65 ± 54.93 | 1016.5 ± 60.14 | 0.0666 | 0.782 |
| MPV (fL) | 9.205 ± 0.52 | 9.305 ± 0.53 | 0.6872 | 0.0008 |
| PCT (%) | 0.26 ± 0.03 | 0.76 ± 0.1 | -0.5067 | 0.0228 |
| PDW (fL) | 9.94 ± 0.85 | 12.38 ± 1.59 | 0.7349 | 0.0002 |

We also found a significant improvement in the WOMAC and VAS scores of the patients when evaluated 6 weeks after PRP injection. (Table 3) The overall WOMAC score mean (pain + stiffness + physical function) was 74.6/96 before treatment which improved to 52.8/96 after treatment. As per the Visual Analog Scale, the initial mean was 7.44 and after 6 weeks was found to be 4.15 which was a significant decrease in terms of pain.

Table 3: WOMAC and VAS scores before and after PRP injection.

| Score | Before treatment (mean ± SD) | After treatment (mean ± SD) | P value (paired t test) |
|---|---|---|---|
| WOMAC | 74.6 ± 10.98 | 52.85 ± 8.6 | <0.0001 |
| VAS | 7.4 ± 0.75 | 4.15 ± 1.18 | <0.0001 |

A positive correlation was found between WOMAC scores and total platelet count, MPV, and PDW, but was not significant. We also found a negative correlation between PCV and WOMAC scores and also between Platelet count and PDW with VAS scores. VAS score had a positive correlation with MPV and PCT. The correlation between PCT and VAS was significant ($p<0.05$). (Table 4)

Table 4: correlation between platelet parameters of PRP on WOMAC and VAS scores

| PRP parameters | WOMAC | | VAS | |
|---|---|---|---|---|
| | R value | P value | R value | P value |
| Platelet count | 0.2148 | 0.36312 | -0.34891 | 0.1327 |
| MPV | 0.42562 | 0.60755 | 0.02696 | 0.25035 |
| PDW | 0.11399 | 0.63255 | -0.1233 | 0.60542 |
| PCT | -0.16987 | 0.4763 | 0.47367 | **0.03492** |

**DISCUSSION**

PRP therapy is recognized as a well-tolerated and minimally invasive approach, especially beneficial for individuals who are not fit for surgical intervention and who are unable to endure prolonged use of oral analgesics. Sánchez et al were pioneers in elucidating the therapeutic potential of PRP for the management of articular cartilage avulsion, as demonstrated in a soccer player's case [14]. Several other studies have described the efficacy of PRP in treating mild to moderate osteoarthritis [8, 15].

Numerous variables like preparation method, activation status, activation method, platelet concentration, leucocyte concentration, the concerned individual, physical form of PRP, method of application, and time of application influence the desired clinical outcome. These properties make it difficult to analyze the effectiveness of PRP in the studies across the literature [16].Preparation under sterile conditions and regular cross-checking of platelet count are important to obtain consistent results. Although it seems that PRP could never be a standardized product, it could be tailored according to the specific requirements of a patient, tissue, anatomic site, or type of lesion [1].

In many of the studies, for a PRP to be effective in clinical treatments it should have approximately 10 lakh platelets or more per microliter of PRP. In our study, we were able to achieve this working definition of PRP with a mean platelet count in the PRP to be 1016.5 ± 60.14 x $10^3$ cells/μL. There was a positive correlation between the patient's platelet count and platelet count in the PRP, Hence our method of PRP preparation yields a sufficient platelet count that produces significant clinical outcomes irrespective of the patient's platelet count. Previous studies have shown that patients with low platelet counts can also yield positive clinical outcomes in OA knee [17].

MPV serves as an indicator of platelet size. Research on conditions such as rheumatoid arthritis and ankylosing spondylitis has revealed that in cases of severe inflammation, MPV values tend to decrease[18,19]. Similarly as the disease progresses, MPV levels show a decreasing trend in Osteoarthritis as well, which is characterized by chronic inflammation and progressive cartilage and bone deterioration, However, following treatment with PRP, MPV values return to normal. This signifies the potential diagnostic and prognostic significance of MPV in OA patients.

Plateletcrit measures total platelet mass as a percentage of volume occupied in the blood. It serves as a screening tool for detecting platelet quantitative abnormalities [20]. PCT is nonlinearly correlated to the platelet count and indicates comparable clinical implications [21]. PRP being a platelet-concentrated product should have a higher PCT and hence influence pain reduction as indicated by VAS score. Study by Kothari et al also showed similar findings [22].

Platelet distribution width (PDW) is a marker of platelet anisocytosis, which describes the size distribution of platelets produced by megakaryocytes and increases upon platelet activation [23]. In our study, we found a significant increase of PDW in PRP-containing activated platelets. These activated platelets help to release more growth factors thereby improving clinical outcomes.

In our study we found that most of the platelet parameters had a positive correlation with the clinical outcome however it was not significant. Quantification of the growth factors released by these platelets will further help to understand the correlation.

## CONCLUSION

In our study, we found that a platelet count of more than 10,000 cells/μL in PRP was sufficient for pain relief. In a developing country like India, PRP could be an affordable option for patients with OA knee. Further research is needed to address the lack of standardization in PRP use, particularly concerning the impact of leukocyte inclusion, activation, and platelet concentration on therapeutic efficacy.

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