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Original Research Article

# Evaluating Functional Improvement in Early Knee Osteoarthritis: A Prospective Study on Intraarticular Autologous Platelet Rich Plasma (PRP) Treatment

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**Abstract:**

Knee osteoarthritis (OA) is a common issue among older adults, often managed with lifestyle adjustments, medications, physiotherapy, and injections like corticosteroids, hyaluronic acid, or autologous platelet-rich plasma (PRP) in the early stages. For advanced cases, surgical interventions like arthroscopic debridement, unicompartmental arthroplasty, patellofemoral arthroplasty, and total knee replacement are performed. Increasingly, autologous PRP injections are being used for Kellgren Lawrence grade 1 and 2 knee OA. This prospective study aimed to evaluate the functional outcomes of OA patients treated with intraarticular PRP over a 15-month follow-up period. The study involved 120 individuals aged 50-70 years with Kellgren Lawrence grade 1 and 2 knee OA. They received a single autologous intraarticular PRP injection and were monitored at 1, 3, 6, 12, and 15-months post-injection. The visual analog scale (VAS) score was assessed at each follow-up. Initially, all patients had a VAS score of 100 mm, which reduced to a range between 13 and 45 at the 1, 3, 6, 12, and 15-month follow-up evaluations.

**Keywords:** Knee osteoarthritis, platelet-rich plasma, intraarticular injection, VAS



## Introduction

Knee osteoarthritis (OA) stands as the most prevalent chronic degenerative joint condition, causing pain and becoming a primary factor in adult disability and dependency. The knee, being the largest synovial joint in humans, is particularly susceptible to this degenerative disease, primarily caused by wear and tear leading to the gradual loss of articular cartilage.

Consequently, patients with knee OA experience pain, fatigue, functional limitations, increased healthcare needs, and impose substantial economic burdens on society. These symptoms severely curtail everyday activities such as standing up from a chair, walking, or climbing stairs, often resulting in observable signs like limping, poor limb alignment, and instability. The diagnosis of knee OA is typically established through weight-bearing X-rays of the knee, including anteroposterior (AP) and lateral views.

### Autologous Platelet-Rich Plasma (PRP)

PRP, defined as plasma with a platelet count surpassing the baseline blood platelet count, is obtained by drawing 50 mL of venous blood from the patient and then centrifuging it to separate PRP from red blood cells and plasma. This autologous PRP is subsequently injected into the affected knee joint. The earliest studies on PRP preparations date back to the 1950s when researchers investigated coagulation processes.

Upon injection, when platelets degranulate, they release growth factors such as transforming growth factor beta, platelet-derived growth factor, epidermal growth factor, vascular endothelial growth factor, fibroblast growth factor, and insulin-like growth factor. These growth factors are believed to possess regenerative properties. Particularly in the context of osteoarthritis, these factors may play a role in inhibiting inflammatory effects on chondrocytes mediated by nuclear factor kappa-light-chain-enhancer of activated B cells and interleukin 1.

In 2009, Dohan Ehrenfest and colleagues introduced a classification system comprising four primary categories of preparations, based on two key parameters: the presence or absence of specific cellular components (such as leukocytes) and the fibrin structure:

**1. Pure PRP or Leukocyte-Poor PRP:** This preparation lacks leukocytes and forms a low-density fibrin network upon activation.

**2. Leukocyte and PRP:** These preparations contain leukocytes and exhibit a low-density fibrin network after activation.

**3. Pure Platelet-Rich Fibrin (PRF) or Leukocyte-Poor PRF:** These preparations lack leukocytes and form a high-density fibrin network. Unlike pure PRP or PRP with leukocytes, these products exist in an activated gel form and cannot be injected.

**4. Leukocyte-Rich Fibrin and PRF:** These preparations contain leukocytes and result in a high-density fibrin network.

**Materials and methods**

This prospective study was carried out at the Department of Orthopaedics, Sanjay Gandhi Institute of Trauma and Orthopaedics Bangalore. 120 symptomatic patients diagnosed with Kellgren Lawrence grade 1 and 2 osteoarthritis (OA), aged between 50 and 70 years, and having a body mass index of ≤ 30, were enrolled after obtaining their informed consent.

All patients underwent outpatient evaluations, including detailed history-taking and physical examinations. Other forms of inflammatory arthritis were ruled out through appropriate investigations. Patient complaints were documented using the visual analog scale (VAS), where a score of 100 mm represented the pain intensity before the procedure. Follow-up assessments occurred at 1, 3, 6, 12, and 15 months. During these visits, patients were asked to mark a point on a scale ranging from 0 to 100 mm (0 indicating no pain and 100 indicating pain equivalent to their pre-procedure condition). The marked point was then measured to determine the level of pain. Lower VAS scores indicated better pain relief, while higher scores indicated the opposite. Additionally, weight-bearing anteroposterior and lateral knee X-rays were taken to grade the severity of knee OA before the procedure.

Results Graded As Per VAS Ipgrading:

Excellent, > 80% pain relief

Good, 60%–80% pain relief Fair

40%–60% pain relief Poor

Patients in this study were not given non-steroidal anti-inflammatory drugs, except for 12 individuals who took a 500 mg paracetamol tablet orally twice a day for a single day. Additionally, all patients were instructed to rest and apply cold compression for one day following the procedure.

PRP, or plasma with an elevated platelet count compared to baseline blood, was prepared by collecting 30–50 mL of venous blood from patients in sterile acid citrate dextrose tubes, resulting in approximately 5–8 mL of PRP.

In this PRP method, primary centrifugation was performed to separate red blood cells (RBCs), followed by secondary centrifugation to concentrate platelets within the final plasma volume. The primary spin occurred at 1500 rotations per minute (RPM) for 18 minutes, distinguishing RBCs from the rest of the blood. After this spin, the blood separated into three layers: plasma with suspended platelets, buffy coat, and RBCs. For PRP preparation, the upper plasma layer and buffy coat were transferred to empty sterile tubes. A second spin at 2500 RPM for 10 minutes resulted in platelet-poor plasma in the upper layer, which was discarded. The concentrated platelets settled in the bottom one-third of the tube, forming PRP.

The platelet count in whole blood was compared to that in PRP. It was found that the platelet concentration in PRP was at least five times higher than in whole blood or baseline blood.

**Procedure**

A solitary injection of 6–8 mL of PRP was administered into the knee joint using a 21-G needle through the super lateral approach. Patients were instructed to rest and apply cold compression for one day.

Patient follow-ups were scheduled at 1, 3, 6, 12, and 15 months post-injection. During each visit, a comprehensive knee examination was conducted, and patients were asked to indicate the level of pain on the VAS scale.

**Statistical Analysis**

The data underwent analysis utilizing repeated analysis of variance. A statistical software program was employed for this analysis, and significance was determined for P-values < 0.05. In our research, we observed a substantial and statistically significant improvement in VAS scores lasting up to 15 months. The average age of the patients in our study was 58 years. Nearly all participants experienced significant relief from pain and improved joint function. A comprehensive breakdown of the results can be found in Table 1.

**Table 1: Follow-up and results after injection of PRP**

| Follow-up duration | Number of patients N | VAS range | Mean VAS | Inference |
|---|---|---|---|---|
| On the day of the procedure | N= 120 | 100–100 mm | 100 mm | |
| At 1 month | N= 120 | 13–33 mm | 25 mm | Good improvement |
| At 3 months | N= 120 | 12–28 mm | 19 mm | Excellent improvement |

| | | | | |
|---|---|---|---|---|
| At 6 months | N= 120 | 15–31 mm | 23 mm | Good improvement |
| At 12 months | N= 120 | 19–41 mm | 25 mm | Good improvement |
| At 15 months | N= 120 | 19–45 mm | 27 mm | Good improvement |

## Discussion

Pharmacological interventions such as NSAIDs, viscosupplementation, and glucocorticoids have been proposed as non-invasive approaches to manage pain and enhance joint mobility in individuals with knee osteoarthritis (OA), albeit with varying success rates. Current treatment strategies emphasize a balanced approach involving nonpharmacological methods, pharmacotherapy, and surgery if initial treatments prove ineffective.

The rising prevalence of knee OA and concerns about the safety of existing pharmacological treatments have created a demand for more effective approaches that not only alleviate symptoms but also repair cartilage damage. Platelet-Rich Plasma (PRP) therapy has emerged as a promising option. PRP stimulates tissue regeneration and slows cartilage degeneration by promoting the movement, multiplication, and differentiation of stem cells into chondrocytes, the cells responsible for cartilage formation.

In this study, we utilized a single injection of leukocyte-poor PRP (LP-PRP) obtained through a double spinning technique, resulting in a sample with platelet concentration five times higher than baseline blood levels. Numerous studies have demonstrated the therapeutic benefits of intraarticular PRP injections for knee OA management.

A meta-analysis conducted by Pu Chen et al. in 2019, involving 1677 patients, indicated that intraarticular PRP injections provide superior pain relief and functional improvement in OA knee patients compared to hyaluronic acid (HA) and placebo, especially in short-term follow-ups (≤ 1 year). Importantly, the study found no significant differences in the risk of adverse effects between PRP and HA or placebo. Other research by Shen et al. in 2017 supported the safety of PRP injections, with no severe complications reported, and all adverse reactions resolving within days. Additionally, a network meta-analysis by Riboh et al. in 2015 compared PRP with other treatments and demonstrated its superior analgesic and functional outcomes over HA.

Prospective studies conducted by Kon et al. in 2010 and supported by findings from Sampson et al. and Filardo et al. affirmed the safety and efficacy of PRP in managing knee OA. Our study, too, showed positive outcomes, with most patients experiencing significant improvements in symptoms and Visual Analog Scale (VAS) scores during the follow-up period compared to their pre-injection values.

While a few patients in our study reported short-term exacerbation of knee pain following the injection, this discomfort was transient and spontaneously resolved within a day. Similar instances of transient pain after PRP injections have been documented in prior studies. Overall, our findings support the growing body of evidence indicating the effectiveness and safety of intraarticular PRP therapy as a viable option for managing knee OA, offering not just symptomatic relief but also potential cartilage repair benefits.

## Conclusion

A group of 120 individuals diagnosed with early-stage knee osteoarthritis (OA) (grades 1 and 2) underwent a single intraarticular injection of their own platelet-rich plasma (PRP). The procedure garnered positive patient acceptance due to its use of autologous material and its affordability. The patients were monitored for a period of 15 months, revealing a significant improvement within the first month. Encouragingly, this positive response was sustained for the entire 15-month duration.

This approach proves particularly beneficial for individuals diagnosed with knee OA in the early stages (Kellgren Lawrence grade 1 and 2).

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