

Efficacy of Platelet-Rich Plasma in Pain Relief and Functional Improvement in Knee Osteoarthritis: A Prospective Study

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ABSTRACT

Background: Knee osteoarthritis is a progressive degenerative disease that can severely impair daily activities due to intense pain from cartilage damage. Platelet-rich plasma (PRP), an autologous treatment, poses minimal risk of disease transmission. This study evaluates the efficacy of PRP in improving pain relief and functional outcomes in patients with Kellgren-Lawrence Grade I-III knee osteoarthritis.

Methods: This 2-year study at a government medical college included 29 patients aged over 35 with primary knee osteoarthritis. After radiographic evaluation and fitness assessment, patients received PRP injections at baseline, 3 weeks, and 6 weeks, with follow-ups over 12 months. WOMAC and VAS scores were evaluated, and changes were analyzed using a paired t-test, with $p < 0.05$ deemed significant.

Result: We studied 40 knees (29 patients, mean age 55.9 years, 75.9% female) with Kellgren-Lawrence Grades I-III osteoarthritis. WOMAC scores improved significantly from 75.65 pre-injection to 66.23 at 3 weeks and 43.93 at 6 months ($p < 0.05$) but worsened by 12 months. VAS scores dropped from 7.18 to 3.90 at 6 months ($p < 0.05$) but increased to 6.38 by 12 months. No major complications occurred, aside from manageable pain and swelling at the injection site.

Conclusion: Platelet-rich plasma injections provided significant pain relief and functional improvement in patients with knee osteoarthritis (Grades I-III) for up to 6 months. However, the effects tended to diminish by 12 months, suggesting the need for further interventions or additional injections for sustained benefits. The procedure was generally safe with minimal complications.

Key-words: Knee OA, PRP, Pain Relief, VAS score, WOMAC Score

INTRODUCTION

Osteoarthritis (OA) is a progressive degenerative disease of synovial joints caused by an imbalance between cartilage regeneration and degeneration, resulting in net cartilage loss.

This process leads to the softening and breakdown of articular cartilage, bone hypertrophy, cyst formation, and subchondral bone sclerosis. ^[1] Pain, deformity, and impaired joint function occur due to osseous outgrowths known as osteophytes. ^[2]

In 1961, Kellgren referred to this condition as "osteoarthrosis," emphasizing its non-inflammatory nature in uncomplicated cases where synovial thickening or infiltration is absent. OA is not associated with systemic illnesses and is more prevalent in weight-bearing joints like the knees, hips, and spine. Its prevalence is higher in individuals with an elevated body

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mass index. Globally, OA is the eighth leading non-fatal disease burden and a major cause of disability. [3] The prevalence of OA in women (18%) is higher than in men (9.6%) over the age of 60. [3] While radiographic evidence of OA is seen in 40% of individuals over 40 years of age, only about half experience symptoms. [2] The incidence of OA increases with age, affecting nearly 80% of people aged 55 and older. [4] Advances in healthcare and increased life expectancy have further contributed to the growing burden of OA. [5] Obesity and high-impact activities, such as sports, also raise the risk of OA, particularly in middle-aged and older adults. [5]

In India, the incidence of OA is approximately 5.78%, accounting for nearly 30% of all rheumatological conditions. Contrary to popular belief, OA prevalence in India is higher than in Western countries, with symptomatic OA (pain on most days of the month along with radiological evidence) affecting 22–39% of the population. [5] Uneven joint loading often contributes to the development of OA, which, while occasionally presenting with inflammation, is essentially non-inflammatory.

Risk factors for secondary OA of the knee include trauma, obesity, tuberculosis, subchondral bone necrosis, gout, and rheumatoid arthritis. Other general risk factors include age, sex, ethnicity, genetic predisposition, trauma, joint overloading, hormonal status, bone density, metabolic and nutritional factors, and failure of joint protective mechanisms. [4]

Diagnosis of knee OA is based on joint radiographs, joint fluid analysis, and blood tests to rule out inflammatory arthritis. The severity of knee OA is graded using the Kellgren and Lawrence classification, ranging from Grade I (mild OA) to Grade IV (severe OA). [6]

Management of knee OA primarily focuses on pain relief and functional improvement. No definitive treatment exists to address the root cause of the disease. Physical exercise and medications, such as acetaminophen, non-steroidal anti-inflammatory drugs (NSAIDs), and intra-articular steroid injections, are effective in delaying disease progression. However, for patients with Grade IV OA or those unresponsive to conservative measures, surgical options like total knee arthroplasty or high tibial osteotomy remain the last resort, despite their associated risks and complications.

PRP was first introduced in clinical practice in 1987 during open-heart surgery. In 2003, Sanchez et al. were

the first to use autologous growth factor-rich plasma for treating musculoskeletal disorders. PRP has since demonstrated its efficacy in alleviating pain in patients with OA. [7]

PRP contains 5–10 times the platelet concentration found in normal plasma, resulting in higher levels of growth factors that accelerate the healing process. Improved outcomes have been reported with PRP injections in certain tendinopathies, and meta-analyses have confirmed its efficacy in treating mild to moderate knee OA. [8]

Given the potential benefits of PRP in reducing pain and improving functional outcomes in knee OA, we conducted this study to evaluate the efficacy of PRP and its functional outcomes in patients with Kellgren-Lawrence Grades I, II, and III knee OA. Additionally, we aimed to identify any complications associated with this procedure.

MATERIALS AND METHODS

Study Design and Setting- This prospective, observational study was conducted in the Department of Orthopedics and Traumatology at the government medical college, datia. The primary aim was to assess the efficacy and functional outcomes of PRP therapy in patients with knee osteoarthritis.

Inclusion Criteria- The patients were eligible for the study if they met the following criteria: age >35 years, of any gender, with a clinical diagnosis of primary osteoarthritis graded as I, II, or III based on the Kellgren and Lawrence classification. Symptoms must have persisted for more than three months, and patients must have shown no significant response to oral medications for knee osteoarthritis. Only those who provided voluntary written informed consent, along with their legally acceptable representatives, were included in the study.

Exclusion Criteria- Exclusion criteria were strictly defined to eliminate confounding factors. Patients were excluded if they had received intra-articular cortisone injections or systemic corticosteroid therapy within the last six weeks, were undergoing anticoagulant therapy, or had inflammatory arthritis, knee instability, or signs of infection around the knee joint. Other exclusion factors included pregnancy or breastfeeding, surgical

intervention on the knee or periarticular areas within three months, uncontrolled diabetes (HbA1c >7.5%), or refusal to provide written informed consent.

Pre-Injection Assessment- Patients and their legally acceptable representatives were provided with detailed study information in their local language, including an explanation of the procedure, potential risks and benefits, complications, and follow-up requirements. Written informed consent was obtained before study enrollment.

A thorough clinical history was taken, focusing on the nature and duration of knee pain, particularly pain exacerbated by walking, as well as prior treatments and their outcomes. Patients with symptoms resulting from trauma or presenting with deformities were excluded. Clinical examination included assessment of tenderness at the medial and lateral joint lines, evaluation of any deformities, and overall knee function.

Investigations

Hematological Investigations- All patients underwent a comprehensive set of laboratory investigations, including viral markers (HIV and HBsAg), complete blood count (CBC), platelet count, total and differential leukocyte counts, random blood sugar levels, and serum uric acid levels to rule out hyperuricemia.

Radiological Investigations- Radiological assessment included anteroposterior (AP), lateral weight-bearing, and patellofemoral skyline views of the knee. Radiographic findings such as the presence of osteophytes, reduced medial joint space, and varus or valgus deformities were noted. Patients with abnormal bony structures on radiographs were excluded from the study.

RESULTS

The study included 29 patients, with a majority in the age group of 51-60 years (12 patients, 41.4%), followed by 9 patients (31.0%) in the 40-50 years age group, 6 patients (20.7%) in the 61-70 years age group, and 2 patients (6.9%) in the age group above 70 years. The mean age of the patients was 55.89 ± 9.14 years, ranging from 40 to 75 years. In terms of gender distribution, 22 patients (75.9%) were female, and 7 patients (24.1%) were male, showing a female predominance with a male-to-female ratio of 1:3.14.



Fig. 1: Plasma is separated after centrifuge

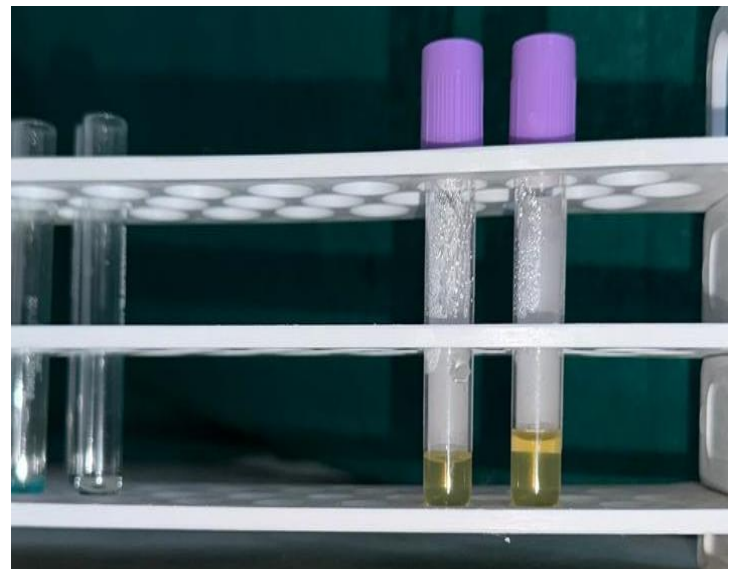


Fig. 2: Platelet rich plasma



Fig. 3: PRP is injected in knee joint

Regarding the distribution of knee involvement, 11 patients (37.9%) had bilateral involvement, while 18 patients (62.1%) had unilateral involvement, resulting in a total of 40 knees being affected. Left knee involvement was observed in 21 knees (52.5%), while right knee involvement was seen in 19 knees (47.5%), indicating a slight predominance of left knee involvement.

The Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) scores were evaluated at different time points. The mean WOMAC score at baseline (pre-injection) was 75.65 ± 5.54 . At 3 weeks post-injection, the score decreased to 66.23 ± 6.95 , showing a statistically significant reduction ($p=0.001$). At 6 weeks, the score further decreased to 55.20 ± 10.52 , again showing a statistically significant improvement from 3 weeks ($p=0.001$). At 6 months, the mean WOMAC score was 43.93 ± 14.11 , demonstrating a significant reduction from the 6-week mark ($p=0.001$). However, at 12 months, the WOMAC score increased to 71.60 ± 6.03 , indicating a significant increase compared to the 6-month score ($p=0.001$).

These findings suggest a significant reduction in the WOMAC score up to 6 months post-injection ($p<0.05$), with a subsequent significant increase at the 12-month follow-up ($p<0.05$). The overall WOMAC score showed sustained improvement up to 6 months, but it worsened at the 12-month follow-up.

The mean Visual Analog Scale (VAS) score for pain was 7.18 ± 0.93 before the injection. At 6 months post-injection, the mean VAS score decreased to 3.90 ± 1.19 , demonstrating a significant reduction in pain ($p=0.001$). However, at 12 months, the VAS score increased to 6.38 ± 1.01 , showing a significant increase compared to the 6-month post-injection score ($p=0.001$). This indicates that while pain was well-controlled at 6 months, it began to worsen again at the 12-month follow-up.

DISCUSSION

Osteoarthritis is a progressive degenerative disease primarily affecting synovial joints, with cartilage degeneration being a central feature. As individuals age, cartilage regeneration diminishes, leading to joint destruction. OA, particularly prevalent in older populations and more common in women, severely impacts the quality of life [9,10]. While nonsteroidal anti-inflammatory drugs (NSAIDs), glucocorticoid injections,

and hyaluronic acid are initial treatments, total knee arthroplasty (TKA) is considered a last resort due to its invasiveness [11].

PRP, derived from the patient's blood, has gained attention for its regenerative potential in treating knee OA. Containing a high concentration of platelets, growth factors, and cytokines, PRP promotes healing through cell migration, angiogenesis, and collagen synthesis [12]. Its application in knee OA has shown promising results [13].

In our study of 29 knee OA patients treated with PRP injections, significant improvements were observed in both pain relief and function, as measured by the Visual Analog Scale (VAS) and Western Ontario and McMaster Universities Arthritis Index (WOMAC). Preoperative WOMAC scores of 75.65 ± 5.54 decreased to 43.93 ± 14.11 at 6 months ($p<0.05$), reflecting meaningful clinical benefits. These findings align with Filardo *et al.* who reported similar improvements [13].

VAS scores also showed a significant reduction in pain from 7.18 ± 0.93 to 3.90 ± 1.19 at 6 months, though pain increased at 12 months, indicating diminishing long-term efficacy [11]. Left knee involvement was more common, supporting previous studies on joint asymmetry in OA [14].

In discussing the efficacy of PRP for knee OA, several studies provide valuable insights. Bennell *et al.*'s clinical trial found no significant differences between PRP and placebo in terms of knee pain or cartilage volume after 12 months, suggesting limited long-term benefits [15]. However, Raeissadat *et al.* demonstrated that PRP, along with platelet-rich growth factor (PRGF), showed sustained benefits at 12 months, outperforming other treatments like hyaluronic acid (HA) and ozone, especially for pain relief and functional improvement [16]. This is consistent with findings from Filardo *et al.* [13] whose meta-analysis indicated improvements in WOMAC scores with PRP compared to placebo and HA, although the quality of evidence was considered low [17]. Bansal *et al.* found that PRP with 10 billion platelets resulted in superior outcomes over HA, including better WOMAC and International Knee Documentation Committee (IKDC) scores, with sustained chondroprotective effects observed over a year [18]. Belk *et al.* also supported the superiority of PRP and bone marrow aspirate concentrate (BMAC) over HA, emphasizing their clinical advantages in knee OA

management [19]. Moreover, Migliorini et al. concluded that PRP was the most effective treatment across all time points, reinforcing its long-term efficacy [20]. Dhillon et al. further highlighted PRP's short-term benefits, particularly in early OA, and underscored the need for improved formulations to enhance its therapeutic potential [21]. These findings collectively point to PRP as a promising treatment, though further research is necessary to optimize its use and establish long-term efficacy.

While the present study demonstrates the potential benefits of PRP therapy for knee OA, it is important to note some limitations. The study excluded patients with Grade IV OA, as PRP is likely to be less effective in advanced stages of the disease where joint destruction is significant [21-24]. Additionally, the lack of a control group in this study limits the ability to directly compare PRP with other therapeutic modalities such as hyaluronic acid injections or corticosteroid therapy. Further randomized controlled trials (RCTs) are needed to establish long-term efficacy and compare PRP to other treatment options.

CONCLUSIONS

Platelet-rich plasma injections exhibit substantial short- to medium-term benefits for patients diagnosed with knee osteoarthritis (Grades I-III), leading to significant enhancements in pain alleviation and functional capacity for a duration of up to six months. Nevertheless, there is a discernible decline in efficacy after twelve months, suggesting the potential necessity for repeated injections or supplementary interventions to maintain long-term benefits. In general, PRP injections are regarded as a safe and effective alternative to more invasive treatment modalities, exhibiting minimal complications. Further research is warranted to optimize treatment protocols and to investigate the potential for improved outcomes through enhanced formulations or adjunctive therapies.

CONTRIBUTION OF AUTHORS

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REFERENCES

- [1] Brittberg M, Imhoff A, Madry H, Mandelbaum B. Cartilage repair current concepts, ESSKA, 1st ed. DJO publication, Guildford, UK. 2010; pp. 3–10.
- [2] Kon E, Filardo G, Drobnic M, Madry H, Jelic M, et al. Non-surgical management of early knee osteoarthritis. *Knee Surg Sports Traumatol Arthrosc.*, 2012; 20(3): 436–49.
- [3] Falah M, Nierenberg G, Soudry M, Hayden M, Volpin G. Treatment of articular cartilage lesions of the knee. *Int Orthop.*, 2010; 34(5): 621–30.
- [4] Heidari B. Knee osteoarthritis prevalence, risk factors, pathogenesis and features: Part I. *Caspian J Intern Med.*, 2011; 2(2): 205-12.
- [5] Gomoll AH, Filardo G, de Girolamo L, Espregueira-Mendes J, Marcacci M, et al. Surgical treatment for early osteoarthritis. Part I: cartilage repair procedures. *Knee Surg Sports Traumatol Arthrosc.*, 2012; 20(3): 450–66.
- [6] Kohn MD, Sassoon AA, Fernando ND. Classifications in Brief: Kellgren-Lawrence Classification of Osteoarthritis. *Clin Orthop Relat Res.*, 2016; 474(8): 1886-93. doi: 10.1007/s11999-016-4732-4.
- [7] Sampson S, Gerhardt M, Mandelbaum B. Platelet rich plasma injection grafts for musculoskeletal injuries: a review. *Curr Rev Musculoskelet Med.*, 2008; 1(3- 4): 165-74. doi: 10.1007/s12178-008-9032-5.
- [8] Platelet rich plasma. Available from: <https://orthoinfo.aaos.org/en/treatment/platelet-rich-plasma-prp>. Accessed on 06.08.2021.
- [9] King LK, March L, Anandacoomarasamy A. Obesity & osteoarthritis. *Indian J Med Res.*, 2013; 138(2): 185-93.
- [10] Hsu H, Siwiec RM. Knee Osteoarthritis. [Updated 2021 Jul 25]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2021. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK507884/>



- [11] Makris EA, Hadidi P, Athanasiou KA. The knee meniscus: structure-function, pathophysiology, current repair techniques, and prospects for regeneration. *Biomaterials*, 2011; 32(30): 7411-31. doi: 10.1016/j.biomaterials.2011.06.037.
- [12] Huber M, Trattning S, Lintner F. Anatomy, biochemistry, and physiology of articular cartilage. *Invest Radiol.*, 2000; 35(10): 573-80. doi: 10.1097/00004424-200010000-00003. PMID: 11041151.
- [13] Filardo G, Di Martino A, Kon E. Platelet-rich plasma for knee osteoarthritis: A systematic review and meta-analysis. *Am J Sports Med.*, 2020; 48(4): 902-08.
- [14] Malik S, Herron T, Mabrouk A. Tibial Plateau Fractures. [Updated 2021 Aug 6]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2021 Jan-. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK470593/>.
- [15] Cherian JJ, Kapadia BH, Banerjee S, Jauregui JJ, Issa K, et al. Mechanical, Anatomical, and Kinematic Axis in TKA: Concepts and Practical Applications. *Curr Rev Musculoskelet Med.*, 2014; 7(2): 89-95. doi: 10.1007/s12178-014-9218-y.
- [16] Bennell KL, Paterson KL, Metcalf BR, Duong V, Eyles J, et al. Effect of intra-articular platelet-rich plasma vs placebo injection on pain and medial tibial cartilage volume in patients with knee osteoarthritis: The RESTORE randomized clinical trial. *JAMA*, 2021; 326(20): 2021-30. doi: 10.1001/jama.2021.19415.
- [17] Raeissadat SA, Ghazi HP, Bahrami MH, Salman RR, Fathi M, et al. The comparison effects of intra-articular injection of platelet-rich plasma (PRP), plasma rich in growth factors (PRGF), hyaluronic acid (HA), and ozone in knee osteoarthritis; a one-year randomized clinical trial. *BMC Musculoskelet Disord.*, 2021; 22(1): 134. doi: 10.1186/s12891-021-04017-x.
- [18] Filardo G, Previtalli D, Napoli F, Candrian C, Zaffagnini S, et al. PRP injections for the treatment of knee osteoarthritis: A meta-analysis of randomized controlled trials. *Cartilage*. 2021; 13(1_suppl): 364S-75S. doi: 10.1177/1947603520931170.
- [19] Bansal H, Leon J, Pont JL, Wilson DA, Bansal A, et al. Platelet-rich plasma (PRP) in osteoarthritis (OA) knee: Correct dose critical for long-term clinical efficacy. *Sci Rep.*, 2021; 11(1): 3971. doi: 10.1038/s41598-021-83025-2.
- [20] Belk JW, Lim JJ, Keeter C, McCulloch PC, Houck DA, et al. Patients with knee osteoarthritis who receive platelet-rich plasma or bone marrow aspirate concentrate injections have better outcomes than patients who receive hyaluronic acid: Systematic review and meta-analysis. *Arthroscopy*, 2023; 39(7): 1714-34. doi: 10.1016/j.arthro.2023.03.001.
- [21] Migliorini F, Driessen A, Quack V, Sippel N, Cooper B, et al. Comparison between intra-articular infiltrations of placebo, steroids, hyaluronic acid, and PRP for knee osteoarthritis: A Bayesian network meta-analysis. *Arch Orthop Trauma Surg.*, 2021; 141(9): 1473-90. doi: 10.1007/s00402-020-03551-y.
- [22] Dhillon MS, Patel S, John R. PRP in OA knee-Update, current confusions and future options. *SICOT J.*, 2017; 3: 27. doi: 10.1051/sicotj/2017004.
- [23] Belk JW, Kraeutler MJ, Houck DA, Goodrich JA, Dragoo JL, et al. Platelet-rich plasma versus hyaluronic acid for knee osteoarthritis: A systematic review and meta-analysis of randomized controlled trials. *Am J Sports Med.*, 2021; 49(1): 249-60. doi: 10.1177/0363546520909397.
- [24] Singh H, Knapik DM, Polce EM, Eikani CK, Bjornstad AH, et al. Relative efficacy of intra-articular injections in the treatment of knee osteoarthritis: A systematic review and network meta-analysis. *Am J Sports Med.*, 2022; 50(11): 3140-48. doi: 10.1177/03635465211029659.

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