

Effectiveness of Intra-Articular Injection of Platelet-Rich Plasma (PRP) In Isolated Patellofemoral Arthritis

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Research Article

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Abstract

Background: Adults commonly develop isolated patellofemoral arthritis (PFA). It has been suggested that platelet-rich plasma (PRP) may be beneficial in the conservative treatment of tibiofemoral knee osteoarthritis (OA). The purpose of this study is to compare patient complaints prior to and following PRP injection for PFA during conservative treatment.

Materials and methods: This study included eighteen female patients with unilateral PFA between the ages of 25 and 40 years. They received a single dose of PRP injections after failing to respond to conservative treatment. The outcome measures, which included VAS and Kujala scores, were compared to a matched group of eighteen patients managed conservatively but successfully. Both groups received the same physiotherapy regimen, and all patients were followed for one year until the final assessment.

Results: At the final follow-up, the PRP group's VAS scale was significantly improved compared to their pre-injection status, with a p-value of < 0.001. However, no statistically significant difference was observed between the PRP and the non-PRP groups that improved with conservative treatment ($p>0.9$). Comparable results were obtained when the two groups' Kujala scores were compared.

Conclusion: Patients with isolated patellofemoral arthritis who do not respond to conservative treatment may benefit from a single PRP injection, which may postpone or eliminate the need for surgical treatment.

Background:

Isolated patellofemoral osteoarthritis (PFA) in the absence of coexisting femorotibial pathology is a relatively common condition affecting younger and more active patients, with a prevalence of 5–8% in general population. [1] The primary symptoms are frequently anterior knee pain and crepitus, exacerbated by ascending or descending stairs and rising from or lowering to a sitting position. [2] According to a review of 31,516 knee arthroscopies, 4% of all knees had grade IV osteoarthritis. Among these patients, 21% had osteoarthritic lesions on the patella. [3] Its prevalence has increased by 9% in patients over the age of 40, and >13% in females, and 15% in males over 60. [1] The lateral facet was the most frequently affected in 89 percent of cases. [4]

Despite its prevalence, treating this painful disorder is difficult due to various possible causes and a lack of knowledge about articular regeneration. Valgus knee alignment has been shown to accelerate the development of lateral patellofemoral arthritis, together with dysplasia of the patella or trochlea and tibial malrotation. The resultant altered direction and strength of the quadriceps femoris contribute to the disease progression.[5]

Conservative therapy is the first option in isolated PFA treatment due to the complexity of the patellofemoral joint structure and insufficient recognition of the joint's biomechanics. While a sizable proportion of patients may benefit from conservative methods, some will resist these treatments and will

eventually require surgery. [6] Rest, activity modification, nonsteroid anti-inflammatory medications [NSAIDs], patellar braces, foot orthoses, patellar banding, exercise, and "biofeedback" and intra-articular steroid injections are the most effective conservative treatment methods. [7]

Recently, biological intra-articular injections such as platelet-rich plasma (PRP), an autologous blood product containing an increased concentration of platelets, have been studied for the treatment of knee OA. [8] The release of growth factors and other molecules, such as platelet-derived growth factor (PDGF), transforming growth factor- (TGF-B), type I insulin-like growth factor (IGF-1), and vascular endothelial growth factor (VEGF), is linked to the efficacy of this treatment. [9] Numerous clinical trials have demonstrated that PRP may be a promising treatment option for OA. [10, 11] McLarnon et al. performed a meta-analysis and concluded that PRP injections were superior to steroids in treating symptomatic OA. [12]

Although there are few studies on the use of PRP in PFA treatment, promising results have been observed. [13,14,15,16] As a result, and based on the success of treating tibiofemoral knee OA, more research is needed to confirm or disprove these findings. This study aims to compare the results of PRP injections in isolated PFA to a control group that received conservative treatment without PRP injection.

Methods:

Patients' enrollment:

The participants in this prospective study were 18 females between the ages of 25 and 40 who had isolated unilateral patellofemoral arthritis for more than three months and had failed conservative treatment. The following criteria were used to select these patients: age range, unilateral PFA, previous failed conservative and physiotherapy program for six weeks using VAS and Kujala scoring, no obvious lower extremity deformities, no neurological problems, and no prior knee surgery in the examined limb. The criteria for exclusion were. BMI is greater than 35 Kg/m^2 , systemic inflammatory diseases, active/chronic infection or history in the knee area, previous knee operation, corticosteroid or hyaluronic acid injection within the previous 12 weeks, bleeding tendency, use of anticoagulant and antiplatelet medications ten days before injection, use of NSAIDs two days before injection, pregnancy, needle phobia; and a platelet count less than 150,000/L.

After being fully informed of the benefits and possible adverse effects,written informed consent was obtained from all the patients before the study. VAS and Kujala scoring systems were used to assess clinical data at month 0 prior to PRP treatment. The Kujala scoring system was used to assess subjective symptoms and functional limitations in patellofemoral disorders. There are thirteen questions in total. These questions assess knee pain associated with ascending and descending stairs, squatting, running, jumping, and sitting for prolonged periods of flexion, limping, swelling, or patella subluxation, the extent of quadriceps muscle atrophy, flexion deficits, and the need for a walking aid. The scoring system ranges from 0 to 100 points for the best to the worst. Excellent results are classified as (95–100), good results as

(84–94), fair results as (65–83), and poor results as (64). [17] The patients were given the Arabic version of this scoring system. [18]

An age- and BMI-matched group of eighteen female patients were included as a control group. These patients received the same conservative treatment as the previous group but did not receive PRP injections. The regimen began with a three-week course of anti-inflammatory medications and continued with a six-week course of physiotherapy and a 12-week home-based program. Patients who achieved a Kujala score of 85 points were not injected with PRP.

Radiographic evaluation included (1) anteroposterior (AP) weight-bearing radiographs of both knees and (2) lateral (20° of flexion), as well as (3) bilateral tangential patella radiographs (30° knee flexion). After that, all radiographs of both groups were interpreted for patellar affection. Besides, AP knee radiographs were evaluated for any tibiofemoral osteoarthritic change and graded according to Kellgren and Lawrence (K/L). [19]

Preparation and injection of PRP:

The GPS III Platelet Concentration System (Biomet Biologics, Warsaw, Indiana, USA) prepared PRP. According to the system's instructions, a sample of patients' venous blood (54 ml) was mixed with 6.0 ml of citrate. The solution was centrifuged at 3200 rpm for 15 minutes, yielding 6.0 mL of buffy coat layer of leukocyte-rich platelet-rich plasma (LR-PRP) solution for intraarticular injection.

The solution was slowly injected from the lateral aspect of the knee next to the patella while it was mildly subluxated, and the knee was flexed under aseptic conditions with fluoroscopic guidance. After the injection, patients were prescribed knee range of motion (ROM) exercises in the flexion/extension direction. All patients were told to avoid activities that could cause pain for the first two days after the injection and rest their knees. NSAIDs were prohibited, but paracetamol and cold compresses were allowed.

Post-Injection program:

The exercise program began two days after the injection with a range of motion exercises, stretching exercises, and isotonic strengthening exercises for 12 weeks. All the exercises were completed with both legs.

Outcome assessment

The Kujala patellofemoral scoring system was used to evaluate knee function. Patients were evaluated at the start and six months later. Patients were questioned about side effects during each round. All of the patients' parameters were recorded on the same follow-up form. The patient's subjective self-assessment of pain was scored on a visual analog scale (VAS) between 0 and 10 points (0 = no pain, 10 = severe pain).)

Statistical analysis:

SPSS (Statistical Package for Social Science) 15.0 for Windows was used to analyze the data. For continuous variables, descriptive statistics were defined as mean/standard deviation or minimum to maximum, while for nominal variables, they were defined as case number (n) and percentage (percent). The Student t-test was used to compare the spread of continuous variables to the normal spread. The Chi-Square test was used to compare discrete variables.

Results:

There was no statistically significant difference in demographic data properties between the groups.

Table-1

Table-1 demographic distribution between groups

Variable	PRP-group	Non-PRP group	P-Value
	n=18/female	N=18/female	
Agent	33±5.5	34.7±6.2	0.59
Affected knee (Rt/Lt)	10/8	9/9	0.61
Weight (kg)	74.5 ±9	75.2 ±8	0.645
Height (cm)	165.7 ± 10	167.4 ±9	0.216
BMI (kg/m ²)	27.1 ± 7	26.8 ±8	0.745

The VAS scale was significantly improved in the PRP group at the final follow-up compared to the pre-injection status, with a p-value < 0.001. However, when compared to the non-PRP group that improved with conservative treatment (p>0.9), no significant difference was observed. Table-2 summarizes the final outcomes. Comparable results were obtained when the Kujala score was compared in three different situations, as illustrated in Figures 1 and 2.

No complications, local or general, were observed during or following injections,

Table-2 : VAS and Kujala score

Final follow-up	Pre-Injection	Post-Injection	P-value (Pre& Post-groups)	Non-PRP	P-value (Post & Non-PRP groups)
VAS (mean±SD)	5±1	1.5±1.2	<0.001	1.5±1	0.72
Kujala (mean±SD)	72±4.8	89.8 ± 2.4	< 0.001	89.6±3	0.36

Discussion:

In this study, patients who did not respond to conservative treatment achieved favorable outcomes following PRP injection and physiotherapy. The findings showed the efficacy of PRP injection as a non-operative treatment option for resistant isolated patellofemoral arthritis.

Anterior knee pain (AKP) is the most common reason adolescents, adults, and physically active individuals consult with a knee orthopedic surgeon. [20] AKP was thought to be caused by chondromalacia patellae until the late 1960s. Numerous authors, however, have been unable to link AKP and chondromalacia patellae conclusively. [21] In the 1970s, AKP was associated with patellofemoral malalignment (PFM), which was frequently treated surgically, with mixed results. [22] The tissue homeostasis theory was proposed in the 1990s by Scott F. Dye and his research group at the University of California, San Francisco. According to this theory, joints are not merely mechanical structures; they are living, metabolically active systems. Pain is caused by a mosaic of physio-pathological factors, including increased osseous remodeling, increased intraosseous pressure, and peripatellar synovitis, all of which result in a reduced "envelope of function" and pain. [23 24] According to Dye's envelope of load acceptance theory, overuse or cyclical overload of soft tissue or bone areas may account for AKP in a significant number of patients who do not have patellofemoral or limb malalignment. Hyperinnervation of the patellar lateral retinacula results in decreased susceptibility to stress and pain. [25] Additionally, stress cycles induce periodic ischemic states in the patellar cartilage. Selfe and colleagues classified AKP patients into three groups based on their oxygenation status: hypoxic, inflammatory, or mechanical. On the other hand, Ischemia may be the source of pain in all three groups, as inflammatory changes can occur not only following stress-induced cartilage ischemia but also following mechanical damage to the vascular system. [26]

These theories can be summarised as follows: abnormal PF joint alignment and trochlear morphology (patella alta and patellar tilt), kinetic and kinematic abnormalities (quadriceps muscle size, strength, and force), rupture and reconstruction of the ACL (anterior cruciate ligament), female gender, age, and body mass index have all been identified as risk factors for progression of PF cartilage deterioration by affecting the functional envelope. [27]

Strengthening and gait retraining is currently the primary stay of treatment for PFA. Additionally, in mild to moderate cases, non-operative measures such as cortisone injections, hyaluronic acid injections, orthobiologics such as platelet-rich plasma [PRP] or stem cell injections, and passive patellar maltracking correction using bracing and taping may be beneficial. Conservative measures are ineffective after 3–6 months, indicating the need for surgical intervention. [28]

PRP contains high concentrations of growth factors, which regulate chondral homeostasis and benefit both the healing and chondrogenesis processes. PRP stimulates the cellular proliferation and matrix synthesis of chondrocytes in vitro. By supplementing the culture medium with PRP, porcine chondrocytes and collagen and proteoglycan syntheses are increased. [29] PRP demonstrated a beneficial effect on cartilage repair and restoration following microfractures in animal and human studies. [30, 31] Moussa et al. demonstrated that PRP has a beneficial effect on chondrocytes, synovial, and stem mesenchymal cells by increasing cell proliferation, extracellular matrix production, and hyaluronic acid syntheses; PRP can also act as a bioactive scaffold in cartilage defects. 32

Meta-analyses of numerous randomized trials have supported the efficacy of PRP intra-articular knee injection in treating tibiofemoral OA. [11, 12, 33–38] However, treating patellofemoral arthritis with intra-articular injections has been linked to a worse outcome. [39]. On the other hand, some studies yielded positive results. [13–16]

The GPS III Platelet Concentration System was used to prepare the PRP, and injection was performed using the buffy coat layer. The composition of this layer was analyzed and found to contain increased platelet concentrations (3-6 times that of the patient's baseline), as well as increased white blood cell concentrations (3-6 times that of the patient's baseline); these included neutrophils, leukocytes, and monocytes, and was dubbed leukocyte-rich platelet-rich plasma (LR-PRP). White blood cells may participate in modulating inflammatory and platelet activation, thereby enhancing the tissue repair mechanism. [40] Zimmermann et al. discovered that an increase in white blood cell count explained between one-third and half of the variation in growth factors observed in their samples. They discovered a positive correlation between the white blood cell count and VEGF levels (a protein known to be produced by white blood cells) and PDGF. [41]

In this study, patients with isolated PRP who do not respond to initial conservative management may benefit from a single well-prepared PRP injection that lasts at least one year. This management mode may benefit this patient population and may result in a delay or cessation of surgical treatment. We found no adverse events associated with the use of PRP injections. Rai and Singh reported that 9 (9.18 percent) of their patients experienced headache, dizziness, sweating, and syncope for approximately 20 to 30 minutes following intra-articular PRP injection.[42] Patel hypothesized that the adverse effects of PRP were caused by the higher CaCl₂ concentration used to prepare the sample. [43]

The study's limitations include small sample size, an observational design with no intention of randomization, and a brief follow-up period. We recommend additional research to address all of these

limitations. However, the study has some strong points, such as the presence of a control group and the strict selection of patients to allow for a more thorough analysis of the outcomes.

Conclusion:

our findings support the use of PRP injections to treat patients with isolated patellofemoral arthritis who are resistant to conservative management prior to undergoing surgery.

List Of Abbreviations:

PRP: Platelet-rich Plasma

OA: Osteoarthritis.

PFA: Patellofemoral arthritis.

AKP: Anterior knee pain.

PDGF: Platelet-derived growth factor

TGF-B: Transforming growth factor.

IGF-1: Type I insulin-like growth factor.

VEGF: Vascular endothelial growth factor.

LR-PRP:Leukocytes-richplatelet-richplasma.

Declarations:

Funding: There is no funding source.

Conflict of interest: the author declares no conflict of interest regarding this article.

Ethics approval: This study was approved by the Institutional Committee Board, Orthopedic Department, Faculty of Medicine, Cairo University.

Consent to participate ;After being fully informed of the benefits and possible adverse effects, written informed consent was obtained from all the patients before the study.

All methods were carried out in accordance with the Ethical Standards of the 1964 Declaration of Helsinki as revised in 2013.

Consent to publish:not applicable.

Availability of data and materials: The datasets used and/or analysed during the current study are not publicly available due to their containing information that could compromise the privacy of the research participants but are available from the corresponding author on reasonable request.

Authors' contribution: IE wrote the main manuscript text and prepared figures, tables, and statistics. IE reviewed the manuscript.

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Figures

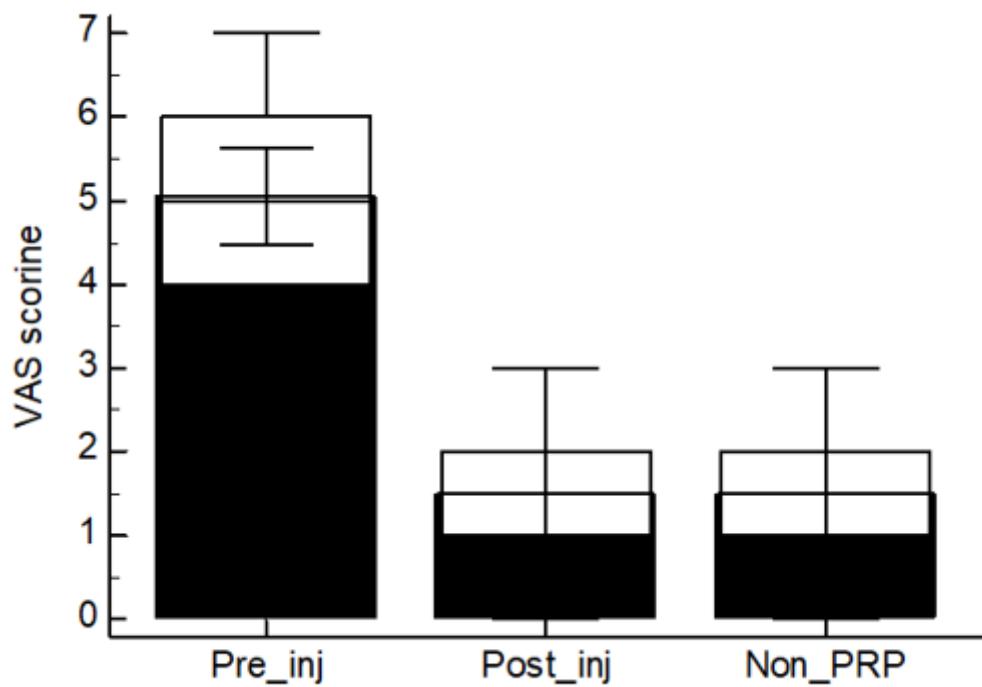


Figure 1

VAS score for pre-PRP-injection status, post-PRP-injection, and non-PRP-injection group

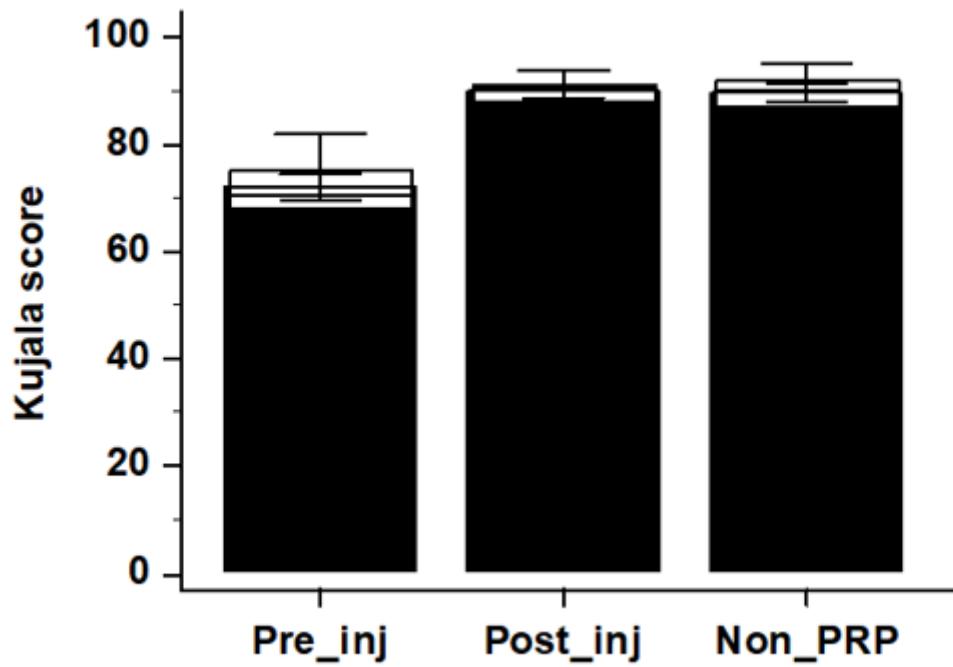


Figure 2

Kujala score for pre-PRP-injection status, post-PRP-injection, and non-PRP-injection group.