



## Physical Function And Performance Effects Of Platelet-Rich Plasma (Prp) In Early-Stage Knee Osteoarthritis

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### Abstract

**Aim:** Osteoarthritis (OA) is a common, painful and degenerative joint disease that causes functional limitation. Pharmaceutical agents, exercise, physical therapy, intra-articular injections and surgery can be counted among treatment applications. In recent years, platelet-rich plasma (PRP) has been considered as an autologous biological therapy used to stimulate cartilage healing and improve symptoms. Although the effects of PRP injection on pain and function of knee OA patients have been widely investigated before, there have been very limited studies about the effects on physical function and performance. In this study, it was aimed to investigate the effectiveness of PRP in improving physical function and performance in patients with knee OA.

**Material and Methods:** This study was performed with 80 stage 1-2 bilateral knee OA patients according to the Kellgren-Lawrence Scale. Intra-articular PRP injection was applied by the same physician at one month intervals. Physical performances of the patients were analyzed twice, just before the first injection and six months after the last injection, with Stair Climb Test (SCT), 50-Foot Walk Test (50 FWT), 30-second Chair Stand Test (30 CST) and Timed Up and Go Test (TUG). In addition, Hospital for Special Surgery (HSS) knee scoring was also recorded as secondary functional result criteria. Paired-t test was used to assess the significance of the difference in before and after injection results.

**Results:** Statistically significant improvement was observed in all physical performance tests (SCT, 50 FWT, 30 CST, TUG) and functional scoring (HSS) at 6 months after PRP application ( $p<0.001$ ).

**Conclusion:** PRP is a safe and effective autologous biological agent in improving physical function and performance in patients with mild to moderate knee OA.

**Keywords:** Function, Osteoarthritis, Knee, Platelet-Rich plasma, Performance

### INTRODUCTION

Osteoarthritis (OA) is a progressive degenerative joint disease and one of the most common causes of pain, disability, and functional limitation in the elderly population (1). It is a multifactorial condition characterized by progressive articular cartilage degeneration, subchondral bone remodeling, osteophyte formation, synovial inflammation, and involvement of periarticular structures, ultimately leading to impaired joint function and reduced quality of life (2,3).

Among all joints, the knee is the most frequently affected site in OA. The prevalence of knee OA has increased substantially in recent years, particularly due to rising obesity rates, increased life expectancy, and higher activity levels in middle-aged and elderly individuals (4,5). Patients with knee OA commonly experience activity-related pain, stiffness, reduced mobility, and difficulty performing daily activities such as walking, stair climbing, and rising from a seated position.

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Conservative management remains the cornerstone of treatment in early-stage knee OA and includes exercise therapy, weight management, pharmacological agents, and intra-articular injections. Intra-articular treatment options such as corticosteroids, hyaluronic acid, and platelet-rich plasma (PRP) have gained widespread use in recent years (1,8). PRP is an autologous blood product with a high concentration of platelets and growth factors that may enhance tissue repair, modulate inflammation, and improve joint homeostasis (9,10).

Several clinical studies have reported that intra-articular PRP injections reduce pain and improve functional outcomes in patients with knee OA, with most outcomes assessed using patient-reported scales such as WOMAC, VAS, and KOOS (11,12). Although these tools are valuable for evaluating symptom severity, they are influenced by subjective pain perception and may not fully reflect actual physical performance (13).

Performance-based objective functional tests provide a more reliable and clinically meaningful assessment of physical function, particularly in conditions such as knee OA where mobility and strength are directly affected. However, despite the increasing use of PRP, studies evaluating its effects on objective physical performance measures in early-stage knee OA remain limited (14).

Therefore, the aim of the present study was to evaluate the effects of platelet-rich plasma treatment on physical performance using objective performance-based tests, including the Stair Climb Test, 50-Foot Walk Test, 30-Second Chair Stand Test, and Timed Up and Go Test, in patients with early-stage knee osteoarthritis. Functional improvement was additionally assessed using the Hospital for Special Surgery (HSS) knee score.

## MATERIAL AND METHODS

This cross-sectional study included a total of 80 patients (57 women, 23 men) aged 35-70 years (mean  $62 \pm 8.15$ ) with bilateral knee OA stage 1 and 2 according to the Kellgren-Lawrence Scale. The local ethics committee approved the study (BAUN 2017/106). Informed consent was obtained from all patients and all procedures were performed by a single physician. Inclusion criteria were symptomatic early-stage (Kellgren Lawrence [KL] stage 1-2) primary knee OA, at least 6 follow-up visits in the same clinic, and monthly follow-up visits. Exclusion criteria were rheumatic disease, intellectual disability, any hematologic disease. Initially, 92 patients with symptomatic early-stage knee osteoarthritis were assessed for eligibility. Twelve patients were excluded from the study due to treatment non-compliance ( $n=7$ ) and loss to follow-up ( $n=5$ ). Consequently, a total of 80 patients who met the inclusion criteria and completed the follow-up period were included in the final analysis.

**PRP Preparation Protocol:** PRP preparation was performed according to the protocol described by Filardo et al. (16). 30-40 mL venous blood was collected sterilely from superficial veins on the surface of the body into kits containing 21 mL sodium citrate. To obtain 8 mL of PRP, 2 centrifugations were performed (the first at 1500 rpm for 6 minutes, the second at 3500 rpm for 12 minutes). The PRP obtained was transferred into 10 cc syringes and divided into 2 equal parts of mL.

The knee area to be treated was prepared by applying povidone-iodine solution. The intervention was performed by lateral approach with the knee flexed at 90 degrees. After the intervention, the patient was taken to the resting room, immobilized and observed for 60 minutes. She was instructed to apply cold to the area where PRP was applied and if she needed analgesic treatment for pain, she was advised to use paracetamol at an appropriate dose according to her body weight.

All patients were evaluated twice with SCT, 50 FWT, 30 CST and TUG just before the first injection and six months after the last injection. A digital stopwatch was used for all tests. In addition, the Hospital for Special Surgery (HSS) knee was also recorded as a secondary functional measurement criterion.

**Stair Climb Test (SCT):** The time (in seconds) of climbing up and down 9 stair steps (20 cm per step) was the score of the test (17).

**50-Foot Walk Test (50 FWT):** The patient's walking time (in seconds) of 50 feet on the stand was the score of the test (18).

**30-second Chair Stand Test (30 CST):** The sit-and-stand-up count on a 17-inch high chair in 30 seconds was the score of the test (17).

**Timed Up and Go Test (TUG):** Standing up from a 17-inch high chair, walking 3 meters, and sitting back time (in seconds) was the score of the test (17).

**Hospital for Special Surgery (HSS):** 7 categories; pain, function, range of motion, muscle strength, flexion deformity, instability, and subtractions were evaluated in a total of 100 points (19).

This study was conducted on patients who were admitted to the Department of Orthopaedics and Traumatology, Faculty of Medicine, Department of Orthopaedics and Traumatology, University of Balıkesir, between 2017 and 2019 and gave consent to participate in the study.

## Statistical Analysis

Demographic characteristics of the patients will be evaluated as mean, standard deviation and percentage. Kolmogorov-Smirnov test will be used for the conformity of the data to normal distribution. Data suitable for normal distribution will be compared with student-t test and data not suitable for normal distribution will be compared with mann whitney-u test. Paired-t test was used to assess the significance of the differ-

ence in before and after injection results. The level of statistical significance was considered as  $p < 0.05$ . Statistical analysis of the data was performed using SPSS v25.0 programme. Post-hoc power analysis was performed using the G Power 3.1.9.4 programme to assess the adequacy of the sample size.  $1 - \beta = 0.961 - \beta = 0.96$  for the sample size. This ratio is above the minimum threshold value of 0.8.

## RESULTS

6 months after the PRP application, there was a statistically significant improvement in all prior physical performance tests (SCT,

50 FWT, 30 CST, TUG) and functional scoring (HSS) ( $p < 0.001$ ). The average pre-injection values for the right and left knee on the HSS scale were  $66.86 \pm 13.66$  and  $66.01 \pm 16.62$  respectively; they became  $77.66 \pm 11.88$  and  $75.71 \pm 13.66$  ( $p < 0.001$ ) 6 months after the injection (Table 1).

In performance tests; pre-injection values in 50 FWT, 30 CST, TUG and SCT measurements were  $51.48 \pm 21.48$ ,  $42.90 \pm 29.68$ ,  $12 \pm 6.57$  and  $41.47 \pm 11.14$  respectively; and 6 months after injection they became  $42.30 \pm 31.45$ ,  $43.71 \pm 28.80$ ,  $10.17 \pm 5.08$ , and  $34.37 \pm 7.89$  ( $p < 0.001$ ) (Table 1).

**Table 1. Physical Performance And Functional Improvement Score Results**

|             |    | Min   | Max | Avg   | Sd ( $\pm$ ) | t      | p      |
|-------------|----|-------|-----|-------|--------------|--------|--------|
| HSS right   | BI | 29    | 97  | 66.86 | 13.66        | -11.11 | <0.001 |
|             | AI | 45    | 100 | 77.66 | 11.88        |        |        |
| HSS left    | BI | 3     | 97  | 66.01 | 16.62        | -9.22  | <0.001 |
|             | AI | 49    | 100 | 75.71 | 13.66        |        |        |
| 50 FWT(sec) | BI | 21.65 | 97  | 51.48 | 21.48        | 2.66   | <0.001 |
|             | AI | 15    | 275 | 42.30 | 31.45        |        |        |
| 30 CST(sec) | BI | 4     | 97  | 42.90 | 29.68        | -4.98  | <0.001 |
|             | AI | 6     | 97  | 43.71 | 28.80        |        |        |
| TUG(sec)    | BI | 6     | 50  | 12    | 6.57         | 3.18   | <0.001 |
|             | AI | 5     | 32  | 10.17 | 5.08         |        |        |
| SCT(sec)    | BI | 19    | 68  | 41.47 | 11.14        | 9.03   | <0.001 |
|             |    | 18    | 56  | 34.37 | 7.89         |        |        |

BI: Before Injection, AI: After Injection, Avg: Average, Sd: Standard deviation

## DISCUSSION

PRP application in OA treatment has become popular in current practice. PRP, as an autologous blood product; contains four to five times more platelet counts, about 1,100 proteins, and 1,500 protein-based bioactive factors (20). Since it is obtained from the patient's blood, it does not carry risks such as transplant diseases, contamination, or tissue rejection. In the joint area where it is injected; type 2 collagen, prostaglandin, and hyaluronic acid synthesis are increased; chondrocyte proliferation, matrix production, and thus cartilage reconstruction are improved. (21, 22). Growth factors in PRP have been reported to have a rapid effect after injection in the joint area, which can last for 6 months and sometimes up to 1 year (10, 23).

The first limitation of PRP studies in OA patients is to have no standard on how many times and at what intervals it should be applied. It was reported that, multiple PRP applications in knee OA yield significantly better results in the EuroQoL visual analog scale (EQ-VAS) and International Knee Documentation Committee (IKDC) subjective scores compared to single dose injection (1). Also, it was reported that 3 doses of PRP were more effective in reducing pain, which was evaluated with VAS and WOMAC scores, compared to 1 and 2 doses (24). Contrary

2 doses were found to reduce pain more than 3 doses which may cause joint effusion (25). In this study, the effects of PRP on functional healing in the joint after three injections at one-month intervals were examined before injection and six months after the last injection and found effective by the literature.

Another important limitation of PRP applications is the inconsistency in the preparation and implementation methods and a standard has not been established in this regard yet. (26). For optimal effect when preparing PRP, it is recommended that the platelet level in its content must be at least 4 times higher than the initial level ( $1.5 - 4.5 \times 10^5/\text{IL}$ ). However, there has not been a consensus to suggest consistent results for the ideal volume amount to be injected. It has been stated in many studies that when 4 ml volume is applied, optimal results are obtained (10,27). In this study, PRP was injected with a volume of 4 ml, prepared by the literature, with the platelet count 4 times concentrated. So far, no major complications have been reported in PRP applications of OA patients except for symptoms such as temporary pain in the injection area, dizziness that passes shortly after the procedure, headache, nausea, sweating, stiffness, and tingling (28,29). We haven't seen any major complications in any of our patients for at least 6 months.

In recent years, many studies have claimed that PRP improves functionality, quality of life, and perception of pain in OA patients. In a review comparing research involving PRP and other intra-articular injection applications in OA patients, researchers found that pain decreased significantly within 3-6 months (VAS score and a submeasure of WOMAC score) and this reduction was significantly higher than hyaluronic acid application except for one study, and in one study the effect was equal (25). Another study examined the improvement in pain and functionality with Knee Injury and Osteoarthritis Outcome Score (KOOS), Visual Analog Scale (VAS), Tegner and Marx scoring systems in 12, 18, and 24 months after PRP injection in early-stage OA; while there was an improvement in all measurements at the 12th month, in all measurements except KOOS and Tegner at the 18th month, no significant difference was found in any measurement at the 24th month compared to the pre-injection values (12). Accordingly, the healing effect of PRP application on functionality seems to last 6-12 months. These effects were evaluated almost entirely by self-reported applications. In evaluating the functional recovery of OA; self-report survey results are closely related to pain reduction, while performance measures do not correlate strongly with pain. (13). These results demonstrate the importance of including performance tests in self-notification surveys while evaluating recovery. Similar to our study, there was a study examining the effects of PRP on OA through performance tests. In this study; the authors compared the effects of PRP in OA patients with timed stand and walk test, 5 sit-and-go test, and 10-meter walk test, and observed significant improvement similar to our study (14).

When the data of our study was evaluated; the positive effects of multiple doses of PRP injections on the functionality and performance of patients reported in previous studies were observed more objectively with performance tests. Maintaining these results with studies of larger numbers of patients and supported by imaging methods such as MRI will determine the clinical value of the application.

## CONCLUSION

PRP is a safe and effective autologous biological agent in improving function and performance in patients with symptomatic mild and moderate knee OA. The role and preferability of repeated intra-articular PRP administration in the treatment protocol in patients with knee OA should be supported by more comprehensive studies.

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**Conflict of Interest Declaration:** The authors declared that there is no conflict of interest.

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**Ethics Approval:** This study was approved by the Clinical Research Ethics Committee of Balıkesir University Faculty of Medicine. The approval was granted on November 1, 2017, with the decision number 2017/106.

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