

Original Article

Clinical Efficacy of Platelet-Rich Plasma in Treating Patellofemoral Chondromalacia: Assessing Long-Term Pain Relief and Functional Outcomes in a 1-Year Follow-Up Local Study

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Abstract

Background: Patellofemoral chondromalacia is a common degenerative knee condition that causes anterior knee pain and limits daily activities. Platelet-rich plasma (PRP) therapy has recently gained attention as a treatment option due to its potential anti-inflammatory and regenerative effects. This study aimed to assess the effectiveness of PRP injections in reducing pain and improving knee function in patients with patellofemoral chondromalacia over a one-year follow-up period. A retrospective cohort study was conducted at Al-Moosa Specialist Hospital in the eastern province of Saudi Arabia between 2020 and 2022. The study included 103 patients aged 18 years or older who were diagnosed with patellofemoral chondromalacia based on clinical examination and imaging findings.

Methods: A retrospective cohort study including 103 patients aged 18 years or older diagnosed with patellofemoral chondromalacia confirmed by clinical examination and imaging. Patients received PRP injections and were followed up for 12 months. Data were extracted from electronic medical records at Al-Moosa Specialist Hospital in Al-Hassa, Eastern Province, Saudi Arabia, including demographics, symptom duration, Outerbridge grade, and changes in pain and functional scores measured using the visual analog scale (VAS) and the anterior knee pain scale (AKPS). Statistical analysis was performed using IBM SPSS version 26.

Results: the mean age of the patients was 32.86 years (SD = 9.54), with 77.7% of the patients being male. Significant improvements were observed in both VAS and AKPS scores. The mean VAS score decreased from 6.42 (SD = 2.52) before treatment to 0.50 (SD = 0.78) at the one-year follow-up (mean difference = -5.91, 95% CI: -6.34, -5.49; $p < 0.001$). The mean AKPS score increased from 81.17 (SD = 11.71) to 96.03 (SD = 5.46) (mean difference = 14.93, 95% CI: 13.18, 16.67; $p < 0.001$). No changes were observed in the Outerbridge grade. Age was significantly associated with greater improvements in VAS and AKPS scores, with older patients showing the most pronounced benefits.

Conclusions: Platelet-rich plasma (PRP) injections were effective in reducing pain and improving knee function in patients with patellofemoral chondromalacia after 12 months. Although symptoms improved, no changes in cartilage structure were observed. PRP appears to be a safe and effective option for symptom relief, but further studies are needed to evaluate its long-term regenerative effects and to compare it with other treatment options.

Keywords: cartilage diseases, follow-up studies, pain, platelet-rich plasma, retrospective studies

Introduction

Patellofemoral chondromalacia, or chondromalacia patellae, is a condition in which the cartilage on the undersurface of the patella softens and degenerates, leading to anterior knee pain and functional impairment (1). The condition is commonly associated with repetitive knee flexion and extension and is observed in both young athletes and older individuals.

The development of patellofemoral chondromalacia is associated with mechanical overload, patellar malalignment, muscle imbalance, and biochemical changes within the cartilage. Chondromalacia patella occurs more frequently in females than in males. Although most prevalent in young women, this condition affects a considerable proportion of the population (up to 30% of athletes and 20%–25% of the general population) and often results in persistent pain, missed work, and reduced participation in sports (2).

Traditionally, management includes physical therapy, nonsteroidal anti-inflammatory drugs (NSAIDs), corticosteroid injections, and surgical interventions. While such treatments may provide temporary relief in many cases, they do not address underlying cartilage damage and therefore often fail to achieve long-term benefits (3, 4).

In recent years, platelet-rich plasma (PRP) therapy has emerged as a regenerative treatment modality for various musculoskeletal conditions involving cartilage injury and osteoarthritis (5). PRP is derived from a patient's own blood and enriched with high concentrations of platelets and growth factors (6). These growth factors are believed to promote tissue healing, reduce inflammation, and stimulate cartilage repair. These biological properties suggest that PRP may represent a potential therapeutic option for cartilage-related disorders, including patellofemoral chondromalacia (7).

Previous research has demonstrated that PRP may reduce pain and improve functional outcomes in patients with knee osteoarthritis and other cartilage pathologies (8, 9). However, despite the growing body of evidence supporting PRP use in

degenerative knee conditions, limited data are available regarding its long-term efficacy in patients with patellofemoral chondromalacia.

This study aimed to evaluate the efficacy of therapy in providing sustained pain relief and functional improvement in patients with patellofemoral chondromalacia at 12-month follow-up, as measured by the anterior knee pain scale (AKPS) and the visual analog scale (VAS) for pain.

Methodology

Study designs

This study utilized a retrospective cohort design to collect and analyse data from patients diagnosed with patellofemoral chondromalacia who received sPRP injections as a treatment modality.

Study area and setting

The study was conducted at Al-Moosa Specialist Hospital, located in Al-Ahsa, the eastern region. This hospital served as the central reference centre for patient data collection.

Study subjects

The study included patients aged 18 years and older who had a diagnosis of patellofemoral chondromalacia based on clinical presentation with anterior knee pain, pain on patellar compression, pain aggravated with movement, crepitus and examination including patellar grind test (**Clarke's test**) or patellar apprehension test and confirmed by imaging findings using the golden standard to diagnose patellofemoral chondromalacia, which is magnetic resonance imaging (MRI). Eligible patients had received PRP injections as a treatment and had follow-up assessments conducted at least 12 months post-treatment. Patients were included irrespective of the timeframe during which treatment was provided, provided they received care at Al-Moosa Specialist Hospital.

The exclusion criteria encompassed individuals with recent trauma or congenital abnormalities since birth that affect the knee. Patients with significant concurrent knee pathologies, such as osteoarthritis, ligament injuries, or rheumatoid arthritis, were excluded. Additionally, patients who received other

concurrent treatments (e.g., corticosteroid injections, surgery, or physical therapy started simultaneously with PRP) or had systemic conditions affecting the healing process (e.g., diabetes mellitus, autoimmune diseases, coagulopathy, or bleeding disorders) were excluded. Records with incomplete baseline or follow-up data, making reliable outcomes assessment at 12 months impossible, were also excluded. Finally, patients with a history of allergic reactions to components used in PRP preparation or injection procedures were omitted from the study.

Sample size and sampling technique

The study aimed to review all the medical records for 130 patients diagnosed with patellofemoral chondromalacia who met the inclusion and exclusion criteria. A retrospective chart review was performed on 103 patients aged 18 years or older who were diagnosed with patellofemoral chondromalacia and confirmed by clinical examination and imaging, and who were eligible for inclusion in this study.

Data management and statistical analysis

Data was collected by trained medical students who

extracted relevant information from patients’ electronic medical records. Collected data were entered into Microsoft Excel and subsequently transferred to IBM SPSS Statistics version 26.0 for analysis.

Baseline data included demographic information (age and sex), duration of symptoms, Outerbridge grade of chondromalacia, and baseline scores on the AKPS and VAS. Details of the PRP treatment, including the number of injections and preparation and injection techniques, were also recorded. Follow-up data included AKPs and VAS scores assessed at 12 months post-treatment.

Data processing involved sorting and coding to ensure accuracy and consistency. Statistical analyses included descriptive statistics to summarize the patient demographics, treatment details, and outcomes.

This methodology ensured a comprehensive, systematic evaluation of PRP injection outcomes in patients with patellofemoral chondromalacia, yielding valuable insights into the effectiveness and safety of this treatment approach.

Table 1: Demographic factors of the patients

		Count	Column n %
Age	Mean (SD)	32.86 (9.54)	
	19-25	33	32.0%
	26-35	28	27.2%
	36-45	29	28.2%
	>45	13	12.6%
Gender	Male	80	77.7%
	Female	23	22.3%
Affected knee	Left	28	27.2%
	Right	75	72.8%
Duration of symptoms (months)	Mean (SD)	17.1 (11.3)	

Results

The study included 103 patients diagnosed with patellofemoral chondromalacia who received PRP injections. The mean age of the patients was 32.86 years (SD = 9.54). Most patients (32.0%) were aged 19–25 years, followed by 28.2% aged 36–45 years,

27.2% aged 26–35 years, and 12.6% aged over 45 years. Male participants constituted the majority of the sample (77.7%), while females made up 22.3%. Regarding the affected knee, the right knee was more frequently involved (72.8%) than the left knee (27.2%). The mean duration of symptoms was 17.1 months (SD = 11.3) (**Table 1**).

Table 2: Difference considering VAS score and AKPS before and one year after PRP

	Before PRP treatment		At one-year follow-up		Mean difference (95 % CI)	P-value
	Mean	Standard deviation	Mean	Standard deviation		
Outerbridge grade	2.30	.79	2.30	.79		
VAS score	6.42	2.52	.50	.78	-5.91 (-6.34, -5.49)	0.000*
AKPS score	81.17	11.71	96.03	5.46	14.93 (13.18, 16.67)	0.000*

PRP: platelet-rich plasma, VAS: visual analog scale, AKPS: anterior knee pain scale

The mean Outerbridge grade remained unchanged before and one year after PRP treatment, with a consistent value of 2.30 (SD = 0.79). Significant improvements were observed in both VAS and AKPS scores at the one-year follow-up. The mean VAS score decreased substantially from 6.42 (SD =

2.52) before treatment to 0.50 (SD = 0.78), with a mean difference of -5.91 (95% ci: -6.34, -5.49; p < 0.001). Similarly, the mean AKPS score increased from 81.17 (SD = 11.71) to 96.03 (SD = 5.46), with a mean difference of 14.93 (95% ci: 13.18, 16.67; p < 0.001) (**Table 2**).

Table 3: The change in VAS and AKPS after one year of PRP

		Count	Column n %
Change Outerbridge grade after PRP treatment on 12-month follow-up	Not changed	102	100.0%
	Worsen	0	0.0%
Change in VAS score at 12 months follows-up	Not changed	0	0.0%
	Improved	103	100.0%
	Worsen	1	1.0%
AKPS score change on 12 months follow-up	Not changed	0	0.0%
	Improved	102	99.0%
	Worsen	1	1.0%

PRP: platelet-rich plasma, VAS: visual analog scale, AKPS: anterior knee pain scale

At the 12-month follow-up, no change in the Outerbridge grade for any patient (100.0%). All patients showed improvement in VAS scores, with no worsening or unchanged scores. Similarly,

99.0% of patients demonstrated improvement in their AKPS scores, while only 1.0% experienced worsening of AKPS scores (**Table 3**).

Table 4: The association between demographic factors and changes in VAS and AKPS scores on 12-month follow-up

	Change the VAS score on 12 months follows up			AKPS score change on 12 months follow up			
	Mean	Standard deviation	P-value	Mean	Standard deviation	P-value	
Age	19-25	-4.61	2.09	0.000*	8.48	19.21	0.003*
	26-35	-5.86	1.92		12.54	8.96	
	36-45	-6.97	1.94		17.72	7.30	
	>45	-7.00	1.73		22.31	7.24	
Gender	Male	-5.76	2.17	0.194	13.37	14.79	0.436
	Female	-6.43	2.19		15.87	6.97	
Affected knee	Left	-6.18	2.16	0.452	17.32	9.49	0.119
	Right	-5.81	2.19		12.67	14.51	

VAS: visual analog scale, AKPS: anterior knee pain scale

Age was significantly associated with changes in both VAS and AKPS scores at the 12-month follow-up. Patients aged 45 years or older showed the largest improvements in both VAS (-7.00, SD = 1.73, $p < 0.001$) and AKPS (22.31, SD = 7.24, $p = 0.003$) scores. Patients aged 36–45 years also showed notable improvements, with mean changes of -6.97 (SD = 1.94) on the VAS and 17.72 (SD = 7.30) on the AKPS scores. Sex and the affected knee did not show statistically significant associations with changes in either VAS or AKPS scores. While females had a slightly greater mean reduction in VAS (-6.43, SD = 2.19) compared to males (-5.76, SD = 2.17), this difference was not statistically significant ($p = 0.194$). Similarly, patients with left knee involvement showed a greater mean improvement in AKPS scores (17.32, SD = 9.49) compared to those with right knee involvement (12.67, SD = 14.51), but this difference was not significant ($p = 0.119$) (Table 4).

Discussion

The main conclusion of this study is that, over the course of a 12-month follow-up period, patients

with patellofemoral chondromalacia experienced significant and long-lasting improvements in pain and functional outcomes following platelet-rich plasma (PRP) injections. The VAS and the AKPS, two patient-reported outcome measures used in this study, both showed significant improvement, indicating significant symptom relief and functional recovery. These findings add credence to the mounting evidence that PRP is a successful biological treatment for knee disorders associated with degenerative cartilage. The noted improvement in knee function and decrease in pain demonstrate PRP's potential as a minimally invasive treatment option that can offer significant clinical benefits to patients who might not respond well to traditional conservative therapies.

One of the study's main conclusions is that PRP treatment significantly reduced pain, as evidenced by the VAS scores at the one-year follow-up. After treatment, the mean VAS score dropped from 6.42 to 0.50, indicating a 92% decrease in pain intensity. This level of pain relief is in line with earlier research showing PRP's analgesic and anti-inflammatory properties. They found a decrease in

mean VAS scores from 7.3 to 1.5, indicating a 79% reduction in pain among patients receiving PRP therapy, whereas Blaga et al. reported a reduction from 7.0 to 2.0, corresponding to a 71% reduction in pain. These results are consistent with the suggested biological mechanisms of PRP, which include the release of cytokines and growth factors that lower inflammation, alter nociceptive pathways, and encourage tissue repair, all of which contribute to long-lasting pain relief. (5, 10–13).

The substantial improvement in knee function, as evidenced by the rise in AKPS scores at the 12-month follow-up, is another noteworthy finding of this study. The average AKPS score increased from 81.17 to 96.03, indicating improved knee mobility, stability, and general functional performance. These results are in line with earlier research showing the functional advantages of PRP treatment for degenerative knee disorders. According to Rodríguez Merchan, PRP improves pain and functional mobility by modulating inflammatory pathways and promoting tissue repair through growth factors like platelet-derived growth factor and transforming growth factor- β in a similar vein, Meheux et al.'s systematic review showed that intra-articular PRP injections considerably enhanced functional outcomes using AKPS and other validated scoring systems. Additionally, Pojala et al. found that PRP therapy enhanced functional capacity and quality of life in patients with osteoarthritis in the knee, supporting PRP's role as a functional disease-modifying treatment as opposed to a purely symptomatic intervention (14–16).

The absence of change in the Outerbridge grade over the course of the one-year follow-up period is another noteworthy finding of this study, despite the notable improvements in symptoms and functionality that were noted. This implies that although PRP is useful for reducing pain and enhancing function, it might not produce detectable structural cartilage regeneration in the time period under investigation. Coincident findings were observed in previous studies, suggesting that PRP acts mainly by biological modulation of inflammation and symptoms rather than significantly intervening in cartilage healing

power, especially at the early to moderate stages of cartilage degeneration. Studies by Filardo et al. and Bennell et al. also found relief of symptoms without an associated morphologic improvement in the cartilage, adding further evidence in favour of the hypothesis that PRP effect might be temporally or mechanistically disconnected from actual morphological regeneration (17–22).

After age grouping (<45 years and \geq 45 years), the older patients reported significantly better treatment effects in the VAS and Japanese Orthopaedic Association scores than the younger patients. This is opposed to some studies, which have shown a decrease in PRP efficacy as patients' age increases, due to the decreasing regenerative ability and bioactivity of platelets with aging. The more advanced improvement of the older patients in this study could also relate to a more severe baseline condition or increased sensitivity to biological modulation than a real regenerative process. Past research findings have shown that the composition of platelets and growth factors released can vary with age, which may have an impact on treatment outcomes. The findings suggest that age should not be used as an exclusion criterion for PRP treatment and highlight the need for more research to be conducted on age-related variations in PRP treatment responses (23–25).

In contrast, sex and laterality did not significantly affect the outcome in the present cohort. The improvements in the VAS and the Australian Great Orthopaedic Association knee score (AKPS) were similar in both sexes and in the right or left knee. These observations are in agreement with previous studies indicating that the effectiveness of PRP therapy is not significantly influenced by the sex of the patients or the affected side. The consistency in the effectiveness of PRP therapy among various demographics is indicative of the generalizability of the therapy among various patient groups (7, 26, 27).

In comparison with other treatment modalities, the present study reinforces the efficacy of PRP as a treatment option in the management of patellofemoral chondromalacia. The conventional

treatment modalities, such as the use of NSAIDs, steroid injections, and physical therapy, may only yield temporary symptomatic relief. These modalities often do not address the biological milieu of the cartilage. The use of PRP has a regenerative and anti-inflammatory effect, which may slow the progression of the disease and delay the need for surgical intervention. However, the absence of a comparative control group in the present study limits the ability to make a direct inference regarding the efficacy of PRP in comparison to other treatment modalities. Further studies are needed to compare the efficacy of PRP with the conventional treatment modalities (28-31).

The study has a number of strengths, such as a good number of participants, the use of outcome measures, and the evaluation of intermediate outcomes at 12 months. However, some limitations need to be highlighted. One such limitation is that, due to a retrospective study design, selection bias may occur. Moreover, the lack of a control group limits causality. Patient-reported outcomes may also show subjective variation. Cartilage changes were assessed structurally using only the Outerbridge grading scale without using advanced imaging modalities. However, results provide clinically important information regarding the effectiveness of PRP in patellofemoral chondromalacia.

In brief, the research demonstrates the safety and efficacy of using PRP injections as a means of reducing pain and increasing function for patients suffering from patellofemoral chondromalacia over the course of one year. While the benefits of using PRP are more indicative of symptomatic relief, the procedure itself is an excellent, minimally invasive biological treatment. To further ascertain the long-term role of the procedure, prospective randomized studies comparing the procedure against other treatments, including imaging for the evaluation of the cartilage, are necessary.

Conclusion

This study supports the use of PRP injections as a safe and effective treatment for reducing pain and improving functional outcomes in patients with patellofemoral chondromalacia. While PRP shows

promise for symptom management, further research is needed to explore its long-term effects on cartilage regeneration and to establish its comparative effectiveness against other therapeutic options.

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Disclosure

Statement

All authors disclose that there is no financial or personal relationship.

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Conflict of interest

There is no conflict of interest.

Ethical consideration

Ethical approval was obtained before initiating the study, approved by the institutional review, number arc 24.9.06, dated 16/9/2024. Confidentiality was strictly maintained throughout the research process. Patient identifiers were anonymized using a coding system to ensure that personal data remained secure and to avoid duplication.

Author contribution

NMA designed and conceptualized the study, prepared the research, and supplied research materials. TMA contributed to data collection, organization, and preliminary analysis. HEA analysed and interpreted data and prepared the first draft of the article. ZSA critically revised the

manuscript for important intellectual content. NAA contributed to data acquisition and provided logistical support. BIA prepared the first draft of the article and harmonized the final revisions. All authors critically reviewed and approved the final manuscript and are responsible for the content and similarity index.

Data availability

The study was conducted at Al-Moosa Specialist Hospital, located in Al-Ahsa, in the eastern region. This hospital served as the central reference center for patient data collection. Data was collected by trained medical students who extracted relevant information from patients' electronic medical records.

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