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Original Article

Evaluating the efficacy of precise platelet-rich plasma injection in grade II meniscus tears

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Abstract: Objectives: This study evaluated the efficacy of precise platelet-rich plasma (PRP) injection, guided by arthroscopy, in patients with grade II meniscus tears. Methods: The study protocol was reviewed and approved by the Institutional Review Board (IRB) of AJA University of Medical Sciences (Code: IR.AJAUMS.REC.1399.258). This study has also been approved by Iranian Registry of Clinical Trials (IRCT) with the code of: IRCT20200217046523N18. In this study, 90 patients with grade II meniscus tears, randomly assigning them to either a PRP injection group (n=45) or a conservative treatment control group (n=45) were enrolled. All patients included in the study had anterior cruciate ligament (ACL) tears and underwent arthroscopic ACL reconstruction. PRP was prepared using a standardized protocol, and injection was performed under arthroscopic guidance using a specialized cannulated loop navigator. Outcomes were assessed using magnetic resonance imaging (MRI) evaluation at baseline, 6, and 12 months post-intervention, and clinical evaluations at the same time points. Results: While the PRP group showed a trend towards improved meniscus tear healing compared to the control group at 6 months (P=0.0552), this difference was not statistically significant at either 6 or 12 months. Similarly, clinical scores showed slight improvements in the PRP group over time, but these differences were not statistically significant compared to baseline or the control group. Conclusion: This study did not demonstrate statistically significant superior outcomes with precise arthroscopically-guided PRP injection as a standalone treatment for grade II meniscus tears compared to conservative management at 6 and 12-month follow-up. Further research with larger sample sizes and longer follow-up periods is needed to definitively assess the role of PRP in the management of grade II meniscus tears.

Keywords: Meniscus tears, platelet-rich plasma, arthroscopy, grade II meniscus tear

Introduction

Meniscal tears are common orthopedic conditions that often result from traumatic injuries or degenerative changes in the knee joint [1]. Among the various types of meniscal tears, grade II tears represent a significant subset, characterized by partial-thickness lesions with variable involvement of the meniscal tissue [2]. Although treatment options for grade II meniscus tears traditionally include conservative management, such as physical therapy and activity modification, emerging therapeutic modalities offer improved outcomes [3-5].

Early diagnosis and treatment of grade II meniscus tears, especially in younger patients, play a crucial role in preventing progression to complete tears (grades 3a, b, and c), which can cause significant burdens on both patients and healthcare systems [6]. Grade II tears are critical junctures in the natural history of meniscal injuries, where timely intervention can halt further degeneration and preserve meniscal function. If left untreated, grade II tears can worsen over time, leading to complete tears characterized by extensive tissue damage and loss of structural integrity [7]. Complete meniscal tears often necessitate more invasive treatments, such as meniscectomy or meniscal repair surgery, which are associated with higher healthcare costs and prolonged rehabilitation periods [8]. By effectively managing grade II meniscus tears with non-invasive methods or minimally invasive procedures, such as platelet-rich plasma (PRP) injection, it is possible to lower the risk of deterioration and the need for surgery. In recent years, PRP has gained atten-

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tion as a potential biological treatment option for musculoskeletal injuries, including meniscal tears [9]. PRP is derived from the patient's blood and comprises a concentrated mixture of growth factors and cytokines that facilitate tissue healing and regeneration [10-12]. Advanced techniques, such as arthroscopy, guide the precise delivery of PRP to the injury site, which can enhance therapeutic efficacy by optimizing the local microenvironment and stimulating tissue repair mechanisms [13].

All studies only examined the effect of PRP as an augmentation to surgical meniscus repair. However, no study has solely focused on evaluating the effect of PRP alone. By augmenting traditional surgical techniques with PRP injections, clinicians aim to improve the healing response and structural integrity of repaired menisci. Several studies have reported favorable outcomes with PRP augmentation, including accelerated recovery, reduced retear rates, and enhanced tissue integration [14-16]. However, limited clinical evidence supports the effectiveness of PRP as a single treatment for meniscal repair, necessitating further research to determine its optimal application and benefit.

In light of these considerations, the present study sought to address the effectiveness of precise PRP injection in patients with grade II meniscus tears rather than as an augmentation treatment alone. By employing a standardized treatment protocol and utilizing advanced techniques for PRP administration, we aimed to rigorously evaluate the therapeutic effects of this intervention on pain relief, functional improvement and radiographic outcomes.

Materials and methods

Study design

The current study, a prospective, randomized controlled trial, aims to assess the effectiveness of PRP injections for patients with grade II meniscus tears referred to our orthopedic centers between February 2022 and December 2023. The study protocol was accepted by the AJA University of Medical Sciences (IR.AJAUMS.REC.1402.253).

Inclusion and exclusion criteria

The inclusion criteria for participating in the study were patients with grade II meniscus tears based on Reicher classification and giving informed and written consent. The Reicher classification categorizes meniscus tears on magnetic resonance imaging (MRI) into four grades: Grade I (no tear) is characterized by a uniformly dark meniscus; Grade II (unlikely tear) shows a slight increase in signal intensity within the meniscus, typically not visible on two consecutive scans; Grade III (probable tear) features a small, linear area of increased signal intensity or a small-to-moderate nonlinear region of heightened signal within the meniscus; and Grade IV (definite tear) involves significant distortion of the meniscus's normal shape, truncation, or a large area or line of increased signal intensity within the meniscus [17]. Participants who had previously undergone PRP treatment, suffered from degenerative meniscal injuries, experienced radial tears, had concurrent fractures, or sustained other ligament injuries were excluded.

Study population

Nineteen patients who met the inclusion criteria were enrolled. Patients were randomly assigned to two groups: the case group (n=45) receiving PRP injection with arthroscopic guidance using a specialized cannulated loop navigator and the control group (n=45) undergoing conservative treatment for grade II meniscus tears.

To ensure comparability between groups, both the case and control groups included only patients who, aside from their meniscal tear, required arthroscopic evaluation for ACL rupture and were candidates for ACL. This selection criterion guaranteed uniformity in the necessity for arthroscopic intervention and postoperative care across all study participants. Patients who did not undergo optimal ACL reconstruction surgery and those who had problems with their ACL surgery were excluded from the study.

Knee arthroscopy technique

The procedure was performed under regional anesthesia with the patient in the supine position on the operating table. Standard portals, including the anterolateral, anteromedial, and posterolateral portals, were established to allow access to the knee joint.

After portal establishment, diagnostic arthroscopy was performed to assess the intra-articu-

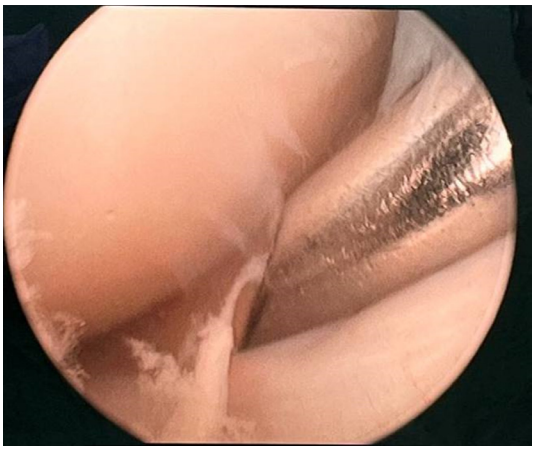

Figure 1. Under the arthroscopic guidance and using a loop navigator, PRP was injected at the site of the Grade II tear, which in this case was the posterior root of the medial meniscus.

lar structures, including the menisci, articular cartilage, ligaments, and synovium. We identified a Grade II tear in the posterior root of the medial meniscus. Under arthroscopic guidance and using a loop navigator, we performed the injection precisely at the identified site.

PRP preparation

As an anticoagulant, we added 3 mL of acid citrate dextrose phosphate buffer to 27 mL of peripheral venous blood in a sterile vacutainer to prepare PRP. Subsequently, the blood underwent two centrifugation procedures. First, a 30 mL vacutainer was spun at 2,800 rpm for 10 min to separate the buffy coat and supernatant fluid. Subsequently, the resulting fluids were transferred to a new sterile vacutainer. The next step involved centrifuging the supernatant plasma for 10 min at 3,200 rpm (second spin). In the end, this procedure produced 4 mL of PRP [18].

Procedure for PRP injection: utilizing a special syringe and arthroscopic guidance

In the case group, PRP injection was performed after diagnostic arthroscopy and ACL reconstruction using a specialized cannulated loop navigator with arthroscopic guidance. The PRP injection technique involved several key steps to ensure precise delivery to the exact site of a grade II meniscus tear.

1. Preparation of PRP: PRP was prepared using standard protocols involving the collection of autologous blood and subsequent centrifugation to concentrate platelets and growth factors. We used a super-dose injection protocol for the PRP.

2. Setup for injection: Following diagnostic arthroscopy, the arthroscopic camera was positioned to visualize the location of the grade II meniscus tear. A specialized cannulated syringe equipped with an arthroscopic guide was used for PRP injection.

3. Localization of meniscus tear: Under arthroscopic guidance, the surgeon identified the exact location and dimensions of the grade II meniscal tear.

4. Precise injection: With the aid of an arthroscopic guide, the surgeon introduced the cannulated loop navigator into the knee joint and navigated it to the targeted site of the meniscal tear. Care was taken to ensure the accurate positioning of the syringe tip within the tear (**Figure 1**).

5. Injection of PRP: Once the syringe was properly positioned, PRP was injected directly into the meniscal tear under real-time arthroscopic visualization (**Figure 2**). The injection was performed slowly to facilitate PRP distribution within the tears.

The PRP injection technique, using arthroscopic guidance and a specialized loop navigator, delivered PRP precisely to the grade II meniscus tear site. This precision optimizes the therapeutic effect and enhances the healing of tissues.

Outcome measurement

MRI evaluation: MRI assessments were crucial for evaluating the efficacy of PRP injections, enabling a comparison of the shape, size, and structural integrity of grade II meniscus tears before and after treatment. According to Lotysch et al. [19], meniscal tears are linear meniscus tears which do not disrupt the articular surface.

Pre-injection MRI evaluation: Prior to PRP injection, all patients underwent MRI of the affected knee to characterize a grade II meniscus tear and establish baseline imaging findings. MRI sequences typically include proton density-weighted, T1-weighted, and T2-weighted

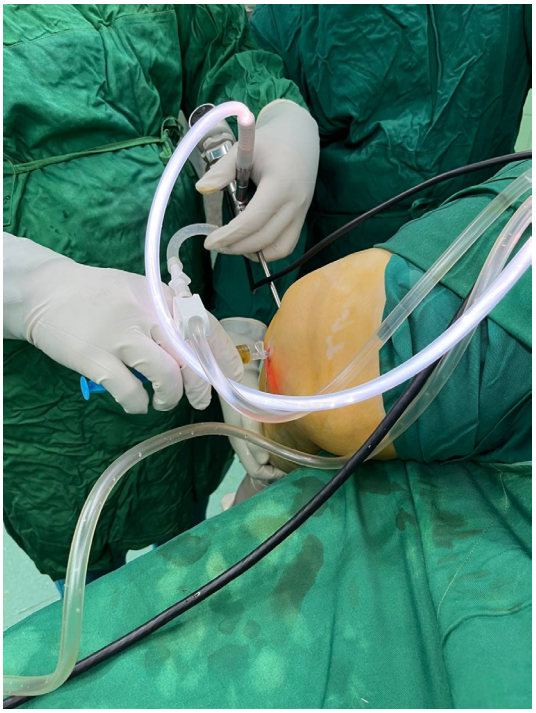

Figure 2. Under arthroscopic guidance, using the loop navigator, PRP injection was performed at the precise site of the tear, which had previously been identified in various MRI views of the patient.

images in various planes (sagittal, coronal, and axial). The patients' MRIs were evaluated by two experienced knee surgeons and one musculoskeletal radiologist. The pre-injection MRI evaluation aimed to delineate the following aspects of meniscal tears:

1. Location and extent: The precise location of the meniscal tear within the meniscal tissue and its extent along the longitudinal and radial dimensions were identified on MRI.

2. Shape and configuration: The shape and configuration of the meniscal tear, including whether it was horizontal, vertical, complex, or radial, were assessed to characterize the tear morphology.

3. Tear stability: The stability of the meniscal tear, including the presence of displaced or unstable fragments, was evaluated to determine the severity of the tear and its potential impact on knee function.

Post-injection MRI evaluation: Following PRP injection, patients underwent repeat MRI examinations at 6 and 12 months post-injection to monitor changes in the meniscal tear and to assess the response to treatment. Similar MRI sequences and planes were utilized for post-injection imaging as in the pre-injection evaluation.

The post-injection MRI evaluation focused on assessing changes in the size and progression of the meniscal tears. According to Kim et al., healing on postoperative MRI can be categorized into the following grades: 1. Complete healing, 2. More than 50% of partial healing and 3. Less than 50% partial healing, and 4. Presence of additional tears or failure to heal [20].

Clinical evaluations: Clinical outcomes were assessed using validated scoring systems, including the International Knee Documentation Committee (IKDC), Lysholm knee scoring scale, Knee Injury and Osteoarthritis Outcome Score (KOOS), and visual analogue scale (VAS) administered to all patients before injection and at 6 and 12 months post-injection. Physical examination findings, such as knee range of motion and specific tests, including the McMurray, Apley, and Thessaly tests, were evaluated before injection and at 6 and 12 months post-injection in both the case and control groups.

Measuring tools

All measuring tools used in the current study were defined below:

The IKDC subjective knee evaluation form is a tool for patients to report outcomes related to knee conditions such as ligament and meniscal injuries, articular cartilage damage, and patellofemoral pain. It includes 18 questions that address symptoms such as pain, stiffness, and swelling, as well as sports and daily activities and current knee function. Responses are scored using an ordinal scale, and the total score is expressed as a percentage (sum of items/maximum possible score) × 100, with 100 indicating no limitations or symptoms [21].

The Lysholm knee scoring scale is another assessment tool for knee-related issues. Originally administered by clinicians, this 8-question survey is now also completed by patients. It evaluates aspects such as limping, support, locking, instability, pain, swelling, stair climbing, and squatting activities. Each question has

Table 1. Meniscus tear healing outcomes at 6 and 12 months post-injection

Time point	Group	Complete healing	Higher than 50% partial healing	Lower than 50% partial healing	Additional tear or failure to heal
6 months post injection	PRP* group	1	3	23	18
	Control group	0	0	12	33
12 months post injection	PRP* group	2	5	27	11
	Control group	0	3	16	26

*PRP: Platelet-rich plasma.

its own scoring system, and the total score ranges from 0 to 100, with 100 signifying no symptoms or disability [22].

The KOOS is a patient-reported measure designed to assess symptoms and function in those with knee injuries and osteoarthritis. It includes five subscales: pain, other symptoms, activities of daily living (ADL), sports and recreation function, and knee-related quality of life (QOL). Each item is rated on a 5-point Likert scale (0-4), and subscale scores are converted to a 0-100 scale, where 0 indicates severe problems and 100 indicates no problems [23].

Pain intensity was measured using the VAS, a 10-centimeter line with endpoints representing no pain (0) and the worst possible pain [10]. Patients mark their current pain level on the line [24].

Statistical analysis

After collecting the study data, they were entered into SPSS software (version 25, IBM Corporation, Armonk, NY) and analyzed. Student's t-tests were used for continuous variables and Fisher exact test was used to analyze the categorical variables. Statistical analysis was performed using appropriate methods to compare the outcomes between the case and control groups at each time point. Differences were considered statistically significant at $P<0.05$.

Results

Participant characteristics

A total of 90 patients with grade II meniscus tears were enrolled in the study and randomly allocated into II groups: the case group (n=45) and the control group (n=45). The mean age of participants was 32.51 years (range: 25-42 years), with a male-to-female ratio of 1:1 (12 females and 33 males in each group).

MRI evaluation

In this study, we compared the healing of meniscus tears in each patient at 6 and 12 months' post-injection with their pre-injection MRI findings. Following PRP injection in the case group, MRI evaluation at 6 and 12 months' post-injection demonstrated a non-statistically significant difference between the case and control groups (**Table 1**). After PRP injection, the case group showed slightly better results than the control group, but the difference was not statistically significant.

For statistical analysis, we classified the complete healing and more than 50% partial healing groups as the "Improved" group, and the failure and less than 50% healing groups as the "No Improved" group. Fisher's exact test was used to calculate the *p*-value for this data (**Tables 2**-**4**).

Clinical evaluations

Clinical outcomes, including the International Knee Documentation Committee (IKDC), Lysholm, and Knee Injury and Osteoarthritis Outcome Score (KOOS) scores, were assessed at baseline and 6 and 12 months post-injection in both the case and control groups. Although the case group demonstrated slight improvements in clinical scores over time, these changes did not reach statistical significance compared to the baseline or control groups (**Table 5**).

To compare the changes in KOOS, Lysholm, IKDC, and VAS scores between the PRP and control groups at 6 and 12 months, we calculated the change from baseline for each group and then used an independent samples t-test to compare these changes. This method

Table 2. Evaluating the 6-month post-injection meniscus tear healing outcomes: Improved vs. Not Improved

Outcome after 6 months	PRP* group	Control group	*P*-value
Improved (Complete + >50%)	4	0	0.0552
Not Improved (<50% + Failure)	41	45	

*PRP: Platelet-rich plasma.

Table 3. Evaluating the 12-month post-injection meniscus tear healing outcomes: Improved vs. Not Improved

Outcome after 12 months	PRP* Group	Control group	*P*-value
Improved (Complete + >50%)	7	3	0.1851
Not Improved (<50% + Failure)	38	42	

*PRP: Platelet-rich plasma.

Table 4. Clinical score evaluations at baseline and 6 and 12 months post-injection

Time point	Score	PRP* group (mean ± SD)	Control group (mean ± SD)
Baseline (before injection)	IKDC	55 ± 10	54 ± 11
	Lysholm	60 ± 8	61 ± 9
	KOOS	58 ± 9	57 ± 10
	VAS	6.5 ± 1.5	6.6 ± 1.4
6 months post-injection	IKDC	75 ± 9	71 ± 10
	Lysholm	72 ± 7	70 ± 8
	KOOS	70 ± 8	69 ± 9
	VAS	4.2 ± 1.2	4.6 ± 1.3
6 months post-injection	IKDC	82 ± 8	81 ± 9
	Lysholm	81 ± 6	79 ± 7
	KOOS	78 ± 7	76 ± 8
	VAS	3.5 ± 1.1	3.9 ± 1.2

*PRP: Platelet-rich plasma, IKDC: International Knee Documentation Committee, KOOS: Knee Injury and Osteoarthritis Outcome Score, VAS: Visual Analogue Scale.

allowed us to assess whether the improvement in scores was significantly different between the two groups.

Discussion

This study aimed to evaluate the efficacy of precise PRP injection as a standalone treatment for grade II meniscal tears. While the results showed a trend towards enhanced healing in the PRP group, particularly in MRI evaluations at the 6-month mark, these improvements were not statistically significant compared to the control group at either 6 or 12 months. Clinical outcome scores (IKDC, Lysholm, KOOS, and VAS) also exhibited modest improvements in the PRP group, but these were not statistically significant compared to the control group. These results suggest that PRP injections may be effective in the management of grade II meniscal tears; however, further investigation is necessary to definitively establish their effectiveness.

The biological rationale for the utilization of PRP in meniscal injuries is predicated on its high concentration of growth factors, cytokines, and other bioactive molecules that are essential for tissue repair and regeneration [25]. Platelets play a crucial role in initiating and regulating the healing process by releasing factors such as platelet-derived growth factor (PDGF), transforming growth factor-beta (TGF-β), and vascular endothelial growth factor (VEGF), which promote angiogenesis, collagen synthesis, and cell proliferation [26-28]. These bioactive components of PRP are hypothesized to exert pleiotropic effects on the cellular and molecular mechanisms involved in meniscus repair, facilitating tissue remodeling and the restoration of structural integrity [29-31].

Previous studies have predominantly focused on the utilization of PRP as an augmentation to surgical meniscal repair, with several investigations reporting improved outcomes, including enhanced repair rates and tissue quality. However, there has been no human study to date that has specifically investigated the effects of PRP alone on grade II meniscal tears. For instance, multiple investigations have demonstrated that PRP can improve outcomes in meniscal repair surgeries, leading to higher rates of healing and enhanced tissue quality [14, 15]. Our study is significant because it focuses on PRP as a primary treatment, rather than an adjunct to surgery, an area that is currently underexplored. While previous studies have shown positive results using PRP to augment meniscal repair surgery, our work directly addresses the question of whether PRP alone can effectively treat grade II tears. For instance, a study by Shin et al. [32] exam-

Table 5. Changes from baseline and statistical analysis

Time point	Score	PRP* group change	Control group change	T-value	*P*-value
6 months	IKDC	20 ± 13.45	17 ± 14.87	0.9615	0.3386
	Lysholm	12 ± 10.63	9 ± 12.04	1.2195	0.2256
	KOOS	12 ± 12.04	12 ± 13.45	0	1.0000
	VAS	-2.3 ± 1.92	-2.0 ± 1.91	-0.7292	0.4676
12 months	IKDC	27 ± 12.81	27 ± 14.18	0	1.0000
	Lysholm	21 ± 10.00	18 ± 11.40	1.2857	0.2017
	KOOS	20 ± 11.40	19 ± 12.81	0.3774	0.7067
	VAS	-3.0 ± 1.85	-2.7 ± 1.84	-0.7407	0.4607

*PRP: Platelet-rich plasma, IKDC: International Knee Documentation Committee, KOOS: Knee Injury and Osteoarthritis Outcome Score, VAS: Visual Analogue Scale.

ined the impact of a single leukocyte-rich PRP (L-PRP) injection on horizontal meniscus tears in rabbit models. This study did not demonstrate a positive impact of a single L-PRP injection on improving the healing of horizontal medial meniscus tears in a rabbit model. A single L-PRP injection may not be effective in promoting the healing of these specific tears. According to Shin et al. [32], one possible reason for the discrepancy between results of this article and those of previous positive studies may be the difference in the PRP delivery method. To enhance the effect of growth factors in meniscus healing, prolonged exposure of these factors to the target area is crucial. This is the reason we used hydrogel in combination with PRP for improvement of PRP exposure in this study. On the other hand, Xiao et al. [33] in another animal study investigated the role of PRP in repairing meniscal white-white zone injuries by promoting the proliferation of canine bone marrow-derived mesenchymal stem cells (BMSCs). They revealed that the use of PRP, either alone or in combination with BMSCs, may enhance the clinical healing rate of meniscal white-white zone injuries.

Our research is crucial as it contributes to the growing body of evidence supporting biological therapies in orthopedic practice, specifically for managing meniscal injuries.

Furthermore, our work builds upon the increasing interest in biological therapies in orthopedics. While traditional treatments for grade II tears involve conservative measures like physical therapy, our approach uses a minimally invasive PRP injection to harness the body's own healing capabilities [34, 35]. Articles supporting the results of our study include those by Goodwillie et al. [9] and Belk et al. [26], which found favorable outcomes associated with PRP augmentation in meniscal repair. Also, Xiao et al. [33] demonstrated potential benefits of PRP in repairing meniscal white-white zone injuries in a canine model. Conversely, Gopinath et al. [36] reviewed studies on percutaneous PRP injection for chronic degenerative meniscal tears, reporting inconsistent improvements in MRI findings but reductions in pain and improved Lysholm and KOOS scores, although the clinical significance remained unclear. This highlights the need for further research to clarify the effectiveness of PRP, particularly as a standalone treatment. Studies like Shin et al. [32], however, contradict our findings, showing no positive impact of a single leukocyte-rich PRP injection on horizontal medial meniscal tears in rabbits. The discrepancy between these studies and our own may be attributed to differences in meniscus tear characteristics, patient populations, PRP preparation, delivery method, and animal models.

The core value of our investigation, and its potential significance, lies in its potential to shift and modify treatment paradigms for grade II meniscal tears. By demonstrating even a trend toward improved healing with PRP injections, we provide evidence that supports the integration of this biological treatment into clinical practice, potentially as a primary treatment option. This less invasive approach, using PRP combined with hydrogel, could expedite recovery and return to activity, a benefit that is particularly relevant for athletes. This approach also aligns with the principles of personalized medicine, where treatments are tailored to individual patient characteristics and needs, such as the specifics of their meniscal tear and their

overall health, to achieve the best possible outcomes. The administration of these injections might alter how we approach meniscal injuries, bringing a targeted, biological therapy to the forefront.

Nevertheless, certain precautions warrant consideration when implementing PRP therapy. Various factors, such as the preparation method, platelet concentration, and timing of administration, can influence the quality and efficacy of PRP. To optimize its therapeutic potential, clinicians must ensure the preparation of PRP using standardized protocols. Furthermore, meticulous patient selection is imperative, as individuals with specific comorbidities or advanced degenerative changes may not exhibit favorable responses to PRP treatment. Moreover, the specific targeting of PRP injection to the exact site of the meniscus tear is paramount for maximizing its therapeutic efficacy. Precise delivery of PRP ensures optimal concentration and distribution of bioactive factors within the injured tissue, enhancing the local microenvironment conducive to healing [37, 38].

In order to improve the effect of PRP on meniscus repair in this study, we used arthroscopic guidance, coupled with a specialized loop navigator, which allows for accurate localization of the tear and controlled injection of PRP directly into the defect, minimizing dispersion and maximizing contact between PRP and the meniscal tissue.

The novelty of this investigation lies in its rigorous evaluation of PRP as a standalone treatment for grade II meniscus tears, utilizing advanced techniques for precise injection under arthroscopic guidance. This methodology not only enhances the accuracy of PRP administration to the targeted area but also optimizes the local microenvironment for tissue repair. By focusing specifically on grade II tears, this research addresses a critical gap in the literature, providing insights that may inform future clinical practices and research directions.

Notwithstanding the promising findings, this study is not without limitations. The relatively small sample size and the short follow-up period constrain the generalizability of the results. Furthermore, the inclusion criteria necessitated the recruitment of patients undergoing arthroscopic evaluation for concomitant orthopedic conditions, which may introduce confounding variables. Subsequent investigations with larger cohorts and extended follow-up durations are imperative to further elucidate the long-term benefits and potential complications associated with PRP injections.

Conclusion

In conclusion, although PRP injection holds promise as a therapeutic intervention for grade II meniscus tears, further research is warranted to elucidate its optimal indications, treatment protocols, and long-term outcomes. Future studies with larger sample sizes, longer follow-up periods, and comparative effectiveness analyses are needed to establish the role of PRP therapy in the management of meniscal injuries and to inform evidence-based clinical practices.

Disclosure of conflict of interest

None.

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References

[1] Luvsannyam E, Jain MS, Leitao AR, Maikawa N and Leitao AE. Meniscus tear: pathology, incidence, and management. Cureus 2022; 14: e25121.

[2] Khalaf AS, El-Sherif AM, Mohamed MF and Zein AM. Role of ultrasonography in evaluation of abnormalities of menisco collateral complex of the knee joint; a comparative study with magnetic resonance imaging, arthroscopy and clinical findings. MJMR 2020; 31: 169-179.

[3] Patel H, Skalski MR, Patel DB, White EA, Tomasian A, Gross JS, Vangsness CT and Matcuk GR Jr. Illustrative review of knee meniscal tear patterns, repair and replacement options, and imaging evaluation. Clin Imaging 2021; 69: 4-16.

[4] Teimouri M, Motififard M, Lalehzar SS, Shahsavan M, Khayam T, Taravati AM and Sadeghian A. Persistent pain following total knee arthroplasty: the role of underlying diseases. J Res Med Sci 2023; 28: 57.

[5] Aghdam HA, Shahrokh SG, Ahmadi O, Rostami K, Najafi MM, Sadeghian A, Hosseini Z and Anaraki KT. Evaluation of the relative frequen-

cy of preinjury activity recovery in anterior cruciate ligament replacement patients: a cohort study. Adv Biomed Res 2024; 13: 117.
[6] Nin DZ, Chen YW, Mandalia K, Parman M, Shah SS, Ramappa AJ, Chang DC and Matzkin EG. Costs and timing of surgery in the management of meniscal tears. Orthop J Sports Med 2024; 12: 23259671241257881.
[7] Li J, Qian K, Liu J, Huang Z, Zhang Y, Zhao G, Wang H, Li M, Liang X and Zhou F. Identification and diagnosis of meniscus tear by magnetic resonance imaging using a deep learning model. J Orthop Translat 2022; 34: 91-101.
[8] Ozeki N, Seil R, Krych AJ and Koga H. Surgical treatment of complex meniscus tear and disease: state of the art. J ISAKOS 2021; 6: 35-45.
[9] Rafieezadeh D. Extracellular vesicles and their therapeutic applications: a review article (part 2). Int J Physiol Pathophysiol Pharmacol 2024; 16: 81-88.
[10] Collins T, Alexander D and Barkatali B. Platelet-rich plasma: a narrative review. EFORT Open Rev 2021; 6: 225-235.
[11] Kunze KN, Pakanati JJ, Vadhera AS, Polce EM, Williams BT, Parvaresh KC and Chahla J. The efficacy of platelet-rich plasma for ligament injuries: a systematic review of basic science literature with protocol quality assessment. Orthop J Sports Med 2022; 10: 23259671211066504.
[12] Rafieezadeh D and Esfandyari G. Marine bioactive peptides with anticancer potential, a narrative review. Int J Biochem Mol Biol 2024; 15: 118-126.
[13] Dhillon MS, Patel S and Bansal T. Improvising PRP for use in osteoarthritis knee-upcoming trends and futuristic view. J Clin Orthop Trauma 2019; 10: 32-35.
[14] Haunschild ED, Huddleston HP, Chahla J, Gilat R, Cole BJ and Yanke AB. Platelet-rich plasma augmentation in meniscal repair surgery: a systematic review of comparative studies. Arthroscopy 2020; 36: 1765-1774.
[15] Xie Y, Xing Q, Wang S, Yang Z, Hu A and Wu Q. Can platelet-rich plasma enhance the effect of meniscus repair? A meta-analysis of randomized controlled trials platelet-rich plasma and meniscus repair. Orthop Surg 2022; 30: 10225536221131483.
[16] Popescu MB, Carp M, Tevanov I, Nahoi CA, Stratila MA, Haram OM and Ulici A. Isolated meniscus tears in adolescent patients treated with platelet-rich plasma intra-articular injections: 3-month clinical outcome. Biomed Res Int 2020; 2020: 8282460.
[17] Reicher M, Hartzman S, Duckwiler G, Bassett L, Anderson L and Gold R. Meniscal injuries: detection using MR imaging. Radiology 1986; 159: 753-757.
[18] Medina-Porqueres I, Martin-Garcia P, Sanz-De-Diego S, Gomez-Caceres A, Moya-Torrecilla F, Reyes-Eldblom M and Rosado-Velazquez D. Clinical and functional outcome of meniscal injuries treated with platelet-rich plasma: a single-center case series. Int J Environ Res Public Health 2022; 19: 7118.
[19] Lotysch M, Mink J, Crues JV and Schwartz SA. Magnetic resonance imaging in the detection of meniscal injuries (abstract). Magn Reson Imaging 1986; 4: 185.
[20] Kim SH, Min K, Kim KI and Lee SH. Clinical and MRI outcomes of repaired peripheral longitudinal tears of the posterior horn of the medial meniscus with ACL reconstruction: results according to tear size. Orthop J Sports Med 2023; 11: 23259671231167535.
[21] Rafieezadeh D, Sabeti G, Khalaji A and Mohammadi H. Advances in nanotechnology for targeted drug delivery in neurodegenerative diseases. Am J Neurodegener Dis 2025; 14: 51-57.
[22] Collins NJ, Misra D, Felson DT, Crossley KM and Roos EM. Measures of knee function: International Knee Documentation Committee (IKDC) Subjective Knee Evaluation Form, Knee Injury and Osteoarthritis Outcome Score (KOOS), Knee Injury and Osteoarthritis Outcome Score Physical Function Short Form (KOOS-PS), Knee Outcome Survey Activities of Daily Living Scale (KOS-ADL), Lysholm Knee Scoring Scale, Oxford Knee Score (OKS), Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), Activity Rating Scale (ARS), and Tegner Activity Score (TAS). Arthritis Care Res (Hoboken) 2011; 63 Suppl 11: S208-S228.
[23] Roos EM. 30 years with the Knee injury and Osteoarthritis Outcome Score (KOOS). Osteoarthritis Cartilage 2024; 32: 421-429.
[24] Crichton N. Visual analogue scale (VAS). J Clin Nurs 2001; 10: 706-706.
[25] Trueba Vasavilbaso C, Rosas Bello CD, Medina Lopez E, Coronel Granado MP, Navarrete Alvarez JM, Trueba Davalillo CA and Gil Orbezo FI. Benefits of different postoperative treatments in patients undergoing knee arthroscopic debridement. Open Access Rheumatol 2017; 9: 171-179.
[26] Belk JW, Kraeutler MJ, Thon SG, Littlefield CP, Smith JH and McCarty EC. Augmentation of meniscal repair with platelet-rich plasma: a systematic review of comparative studies. Orthop J Sports Med 2020; 8: 2325967120926145.
[27] Kaminski R, Maksymowicz-Wleklik M, Kulinski K, Kozar-Kaminska K, Dabrowska-Thing A and Pomianowski S. Short-term outcomes of percutaneous trephination with a platelet rich

plasma intrameniscal injection for the repair of degenerative meniscal lesions. A prospective, randomized, double-blind, parallel-group, placebo-controlled study. Int J Mol Sci 2019; 20: 856.

[28] Kurnaz R and Balta O. Effect of platelet-rich plasma and platelet-rich fibrin matrix on healing of vertical meniscal tears in a rabbit model. Acta Orthop Traumatol Turc 2020; 54: 186.

[29] Li Z and Weng X. Platelet-rich plasma use in meniscus repair treatment: a systematic review and meta-analysis of clinical studies. J Orthop Surg Res 2022; 17: 446.

[30] Freymann U, Metzlaff S, Krüger JP, Hirsh G, Endres M, Petersen W and Kaps C. Effect of human serum and 2 different types of platelet concentrates on human meniscus cell migration, proliferation, and matrix formation. Arthroscopy 2016; 32: 1106-1116.

[31] Lu HT, Lu JW, Lee CH, Peng YJ, Lee HS, Chu YH, Ho YJ, Liu FC, Shen PH and Wang CC. Attenuative effects of platelet-rich plasma on 30 kDa fibronectin fragment-induced MMP-13 expression associated with TLR2 signaling in osteoarthritic chondrocytes and synovial fibroblasts. J Clin Med 2021; 10: 4496.

[32] Shin KH, Lee H, Kang S, Ko YJ, Lee SY, Park JH and Bae JH. Effect of leukocyte of platelet-rich plasma on 30 kDa fibronectin horizontal medial meniscus tear in a rabbit model. Biomed Res Int 2015; 2015: 179756.

[33] Xiao WF, Yang YT, Xie WQ, He M, Liu D, Cai ZJ, Yu DJ, Li YS and Wei LC. Effects of platelet-rich plasma and bone marrow mesenchymal stem cells on meniscal repair in the white-white zone of the meniscus. Orthop Surg 2021; 13: 2423-2432.

[34] Haghpanah B, Tavakoli F, Mollaabbasi M, Azadchehr MJ, Afsharirad A, Sadeghian A, Taravati A, Shahrokh SG and Dastgerdi AS. Comparison the effect of rehabilitation at home and outpatient physiotherapy after total knee arthroplasty surgery on quality of life and knee function: a clinical trial study. Adv Biomed Res 2024; 13: 51.

[35] Teimouri M, Majedi MÀ, Hosseini A, Aliakbari M, Motififard M, Taravati A, Zand F, Sadeghian A and Moghadam MB. Comparison of postoperative pain and clinical outcomes of total knee arthroplasty among patients with rheumatoid arthritis and osteoarthritis referred to clinic or emergency department. Adv Biomed Res 2023; 12: 244.

[36] Gopinatth V, Batra AK, Chahla J, Smith MV, Matava MJ, Brophy RH and Knapik DM. Degenerative meniscus tears treated non-operatively with platelet-rich plasma yield variable clinical and imaging outcomes: a systematic review. Arthrosc Sports Med Rehabil 2024; 6: 100916.

[37] Lietman SA, Hobbs W, Inoue N and Reddi AH. Effects of selected growth factors on porcine meniscus in chemically defined medium. Orthopedics 2003; 26: 799-803.

[38] Elphingstone JW, Alston ET and Colorado BS. Platelet-rich plasma for nonoperative management of degenerative meniscal tears: a systematic review. J Orthop 2024; 54: 67-75.