Research Square

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Three-Month Clinical Outcomes and Exploratory Gait Changes After Intra- Articular Platelet-Rich Plasma for Mild-to-Moderate Knee Osteoarthritis: A Prospective Single-Arm Study

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Abstract

Background: Platelet-rich plasma (PRP) is used to treat knee osteoarthritis (KOA), yet its effects on gait are less clear than its effects on patient-reported symptoms.

Methods: This prospective, single-center, single-arm pre–post study enrolled patients with symptomatic Kellgren–Lawrence grade I–II KOA. Participants received three intra-articular PRP injections at 7–14-day intervals. The primary outcome was the change in Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) total score from baseline to 3 months. Secondary and exploratory outcomes included the International Knee Documentation Committee (IKDC) score, three-dimensional gait measures, PRP cellular composition, and safety.

Results: Of 50 enrolled participants, 40 completed the 3-month follow-up. WOMAC total score decreased from 120.92 ± 22.16 to 73.45 ± 22.07 (mean change, −47.48; 95% CI, −54.57 to −40.38; $P < 0.001$; Cohen's dz = −2.14), whereas IKDC score increased from 37.83 ± 3.14 to 44.12 ± 6.36 (mean change, 6.30; 95% CI, 4.31 to 8.29; $P < 0.001$; Cohen's dz = 1.01). Among 11 exploratory gait outcomes, only the shoulder-hip to hip-knee angle remained significant after overall false discovery rate correction ($q < 0.001$). Maximum knee flexion remained significant only in a domain-specific sensitivity analysis. PRP showed approximately fivefold platelet enrichment and was classified as leukocyte-rich, red blood cell-containing PRP. No serious adverse events occurred.

Conclusions: Three injections of leukocyte-rich, red blood cell-containing PRP were followed by short-term clinical improvement and a small number of gait changes in mild-to-moderate KOA. Controlled studies with longer follow-up are needed to determine whether these changes are attributable to PRP.

Trial registration: Chinese Clinical Trial Registry, ChiCTR2500099663. Registered 27 March 2025, retrospectively registered.

Background

Knee osteoarthritis (KOA) causes pain, progressive joint damage, and loss of function [1]. The burden is increasing, particularly among women and older adults [2]. Changes in gait and compensatory movement may further restrict daily activity and alter joint loading [3,4]. Despite the range of available treatments, many patients continue to have symptoms.

Non-surgical treatment includes exercise, analgesics, non-steroidal anti-inflammatory drugs, and intra-articular injections [5]. Relief is often incomplete or temporary. Platelet-rich plasma (PRP) is an autologous blood product containing concentrated platelets and bioactive mediators that may affect inflammation and joint homeostasis [6]. Clinical trials and meta-analyses have reported improvements in pain and self-reported function, especially in early or mild-to-moderate KOA [7].

Most studies of PRP in KOA have focused on questionnaires. Much less is known about how patients move after treatment. Instrumented gait analysis can detect changes in timing, knee motion, and

proximal compensation that symptom scores do not capture [3,4]. One prospective study found symptomatic improvement after PRP but did not examine gait mechanics [8].

We assessed clinical outcomes and gait 3 months after a series of three intra-articular PRP injections in patients with mild-to-moderate KOA. The primary outcome was the change in WOMAC total score. IKDC score was secondary, and the prespecified gait measures were exploratory. We expected clinical improvement to be accompanied by changes in some gait variables, rather than a uniform return toward normal gait.

Methods

Study design and participants

This prospective, single-center, single-arm pre–post study was conducted at Xuanwu Hospital, Capital Medical University, from January to October 2025. The institutional ethics committee approved the protocol (No. [2024] 011-001), and the trial was registered in the Chinese Clinical Trial Registry (ChiCTR2500099663) on 27 March 2025 (retrospectively registered). The study followed the Declaration of Helsinki, and all participants provided written informed consent. Assessments were completed before the first PRP injection and 3 months later. Each participant contributed one prespecified index knee as the analytical unit.

The manuscript adheres to applicable CONSORT guidance for clinical trial reporting; items specific to randomized controlled trials, including allocation, blinding, and between-group comparisons, were not applicable to this single-arm pre–post design.

Participants were eligible if they were 40 to 70 years old, had symptomatic KOA classified as Kellgren–Lawrence (KL) grade I or II on weight-bearing radiographs [9], had a baseline WOMAC total score of at least 40, and could understand the study procedures and provide written informed consent. Exclusion criteria were severe cardiac, hepatic, pulmonary, renal, neurological, or cardiovascular disease; malignancy; active systemic or local infection; hematologic or coagulation disorders that precluded PRP preparation; aspartate aminotransferase or alanine aminotransferase concentrations greater than 2.5 times the upper limit of normal; prothrombin time, activated partial thromboplastin time, or international normalized ratio greater than 1.5 times the upper limit of normal; hemoglobin of 110 g/L or less; platelet count of 120×10^9/L or less; surgery on the index knee within 6 months before screening; planned knee surgery during follow-up; intra-articular injection in the index knee within 3 months before screening; recent systemic glucocorticoid, anticoagulant, or antiplatelet treatment; pregnancy or lactation; participation in another interventional trial; or any condition judged likely to compromise safety or adherence.

Sample size was estimated for a paired pre–post analysis of WOMAC total score. Because no anchor-based minimal clinically important difference was available for this protocol, one-half of the baseline standard deviation reported by Patel et al. (17.83 points) was used as an approximate meaningful

change, consistent with Norman et al. [10,11]. This yielded a target difference of 8.92 points and an assumed standardized paired effect size of approximately 0.5. With two-sided α = 0.05 and 80% power, approximately 34 analyzable participants were required. The target was increased to 40, and 50 participants were enrolled to allow for incomplete follow-up.

PRP preparation, injection, and concomitant treatments

Participants received three intra-articular PRP injections at 7–14-day intervals. At each session, 50 mL of venous blood was mixed with 4 mL of 2.5% sodium citrate. Blood was centrifuged at 2,000 rpm for 10 min using a Paili centrifuge (Guangzhou, China), after which approximately 20 mL of the lower red blood cell fraction was removed. The remaining component was centrifuged at 2,000 rpm for 10 min using a Weigao centrifuge (Shandong, China). Approximately 26 mL of upper plasma was removed, and the residual fraction was resuspended to yield approximately 4 mL of PRP. An automated hematology analyzer measured platelet, white blood cell, and red blood cell concentrations in peripheral blood and PRP.

PRP was administered under aseptic conditions through a superomedial patellar approach with a 5-mL syringe and 22-gauge needle, without ultrasound guidance. Before joint puncture, 2 mL of lidocaine was infiltrated layer by layer along the puncture tract but was not injected into the joint cavity. Approximately 4 mL of prepared PRP was then injected into the index knee. Participants were advised to avoid strenuous activity for 48 h after each injection.

Concomitant treatments were recorded throughout follow-up. Additional intra-articular injections and index-knee surgery were prohibited. Non-steroidal anti-inflammatory drugs were prohibited for 2 days before each injection, and systemic corticosteroids for 14 days. Treatments required for other conditions or adverse events were permitted and documented.

Outcome assessment

WOMAC total score was assessed at baseline and 3 months as the primary outcome. The 24-item visual analogue scale-based questionnaire ranges from 0 to 240, with higher scores indicating worse symptoms and function [12]. The IKDC subjective knee form was a secondary outcome and ranges from 0 to 100, with higher scores indicating better knee-specific symptoms and function [13]. Both outcomes referred to the prespecified index knee.

Gait was assessed at both time points using a BTS-Bioengineering three-dimensional motion-analysis system (BTS Bioengineering, Italy). The system included eight high-definition infrared cameras, reflective markers, and four 0.5 × 1.0 m force plates. Testing was performed on a 2 × 10 m overground walkway centered within the camera array.

Reflective markers were attached to predefined bilateral upper-body, spinal, pelvic, and lower-limb landmarks, including the acromia, C7, T4, T7, T12, L3, S2, anterior and posterior superior iliac spines, greater trochanters, femoral condyles, mid-shanks, malleoli, calcanei, and toe web spaces. After a

standing trial, participants walked continuously for 6 min at a self-selected comfortable speed. Marker trajectories and ground-reaction forces were recorded synchronously.

Data were processed using SMART software (version 1.10.470.0; BTS Bioengineering, Italy). Three-dimensional marker trajectories were filtered with a recursive Butterworth low-pass filter at 10 Hz. Prespecified spatiotemporal outcomes were stance phase percentage, stride length, step length, gait cycle frequency, and step width. SMART exported gait cycle frequency as cycles/min. Prespecified kinematic outcomes were the wrist-elbow to elbow-shoulder, elbow-shoulder to shoulder-hip, shoulder-hip to hip-knee, and hip-knee to knee-ankle angles, plus maximum knee extension and flexion.

Baseline variables included age, sex, body mass index, index-knee side, and KL grade. Adverse events were monitored through 3 months of follow-up and included injection-site pain, swelling, erythema, hematoma, systemic reactions, and serious adverse events.

Statistical analysis

The primary endpoint was the within-participant change in WOMAC total score from baseline to 3 months. Continuous variables are reported as mean ± standard deviation or median (interquartile range). Normality of paired changes was assessed using the Shapiro–Wilk test. Normally distributed changes were analyzed using paired t-tests; otherwise, Wilcoxon signed-rank tests were used. Effect sizes were Cohen's dz or matched-pairs rank-biserial correlations, as appropriate.

All tests were two-sided, with $P < 0.05$ for the primary WOMAC analysis. The 11 gait outcomes were exploratory. Nominal P values were supplemented with Benjamini–Hochberg false discovery rate (FDR) q values across all outcomes and within prespecified spatiotemporal and kinematic domains [14]. Domain-specific analyses were exploratory sensitivity analyses. Complete cases with baseline and 3-month data were analyzed without imputation (n = 40). Analyses were performed in GraphPad Prism 8 and independently reproduced in R to verify effect sizes, confidence intervals, and FDR adjustments.

Results

Participant characteristics

Fifty participants received the first PRP injection. Three did not complete the injection series, and seven additional participants missed the 3-month follow-up. The complete-case analysis included 40 participants (80.0%), each contributing one index knee (Figure 1). The cohort included 26 women (65.0%) and 14 men (35.0%), with a mean age of 57.85 ± 6.27 years and body mass index of 25.79 ± 4.22 kg/m². Nineteen knees (47.5%) were KL grade I and 21 (52.5%) were grade II; 16 (40.0%) were left and 24 (60.0%) were right (Table 1). No analyzed participant received structured physiotherapy or used a knee brace.

Table 1. Baseline characteristics of the study cohort

Characteristic	Total (n = 40)
Age, years	57.85 ± 6.27
Age range, years	44–68
Female sex, n (%)	26 (65.0)
Male sex, n (%)	14 (35.0)
Body mass index, kg/m²	25.79 ± 4.22
Left index knee, n (%)	16 (40.0)
Right index knee, n (%)	24 (60.0)
Kellgren–Lawrence grade I, n (%)	19 (47.5)
Kellgren–Lawrence grade II, n (%)	21 (52.5)
Baseline WOMAC total score	120.92 ± 22.16
Baseline IKDC score	37.83 ± 3.14

Data are mean ± standard deviation unless otherwise indicated. IKDC, International Knee Documentation Committee subjective knee form; WOMAC, Western Ontario and McMaster Universities Osteoarthritis Index.

Clinical outcomes

WOMAC total score decreased from 120.92 ± 22.16 at baseline to 73.45 ± 22.07 at 3 months (mean change, −47.48; 95% confidence interval [CI], −54.57 to −40.38; P < 0.001; Cohen's dz = −2.14) (Figure 2a and Table 2). IKDC score increased from 37.83 ± 3.14 to 44.12 ± 6.36 (mean change, 6.30; 95% CI, 4.31 to 8.29; P < 0.001; Cohen's dz = 1.01) (Figure 2b and Table 2).

Table 2. Changes in patient-reported clinical outcomes at 3 months

Outcome	Baseline	3 months	Mean change (95% CI)	P value	Cohen's dz
WOMAC total score	120.92 ± 22.16	73.45 ± 22.07	−47.48 (−54.57 to −40.38)	<0.001	−2.14
IKDC score	37.83 ± 3.14	44.12 ± 6.36	6.30 (4.31 to 8.29)	<0.001	1.01

Change was calculated as the 3-month value minus the baseline value. Values are presented as mean ± standard deviation and mean change (95% CI). Cohen's dz was calculated as the mean paired change divided by the standard deviation of the paired changes. P values were obtained using two-sided paired t-tests. CI, confidence interval; IKDC, International Knee Documentation Committee; WOMAC, Western Ontario and McMaster Universities Osteoarthritis Index.

Gait outcomes

Three of 11 exploratory gait outcomes changed at the nominal threshold (Figure 3 and Table 3). Gait cycle frequency decreased by 3.67 cycles/min (95% CI, −6.89 to −0.45; P = 0.027), the shoulder-hip to hip-knee angle increased by 1.93° (95% CI, 1.26 to 2.60; P < 0.001), and maximum knee flexion increased by 2.83° (95% CI, 0.64 to 5.01; P = 0.013).

After FDR correction across all outcomes, only the shoulder-hip to hip-knee angle remained significant (q < 0.001). Overall q values were 0.097 for gait cycle frequency and 0.069 for maximum knee flexion. No spatiotemporal outcome survived domain-specific correction. Within the kinematic domain, the shoulder-hip to hip-knee angle (q < 0.001) and maximum knee flexion (q = 0.038) remained significant. No other gait outcome changed nominally.

Table 3. Changes in gait outcomes at 3 months

Outcome	Baseline	3 months	Mean change (95% CI)	Cohen's dz	P value	Overall FDR q	Domain-specific FDR q
Stance phase (%)	59.01 ± 2.30	59.23 ± 2.52	0.23 (−0.90 to 1.36)	0.06	0.687	0.808	0.687
Stride length (cm)	105.43 ± 17.48	109.07 ± 14.90	3.64 (−3.78 to 11.06)	0.16	0.327	0.585	0.545
Step length (cm)	58.59 ± 7.81	59.27 ± 6.14	0.69 (−2.56 to 3.94)	0.07	0.670	0.808	0.687
Gait cycle frequency (cycles/min)	48.94 ± 6.50	45.27 ± 5.23	−3.67 (−6.89 to −0.45)	−0.36	0.027	0.097	0.133
Step width (cm)	15.38 ± 2.33	15.96 ± 2.38	0.58 (−0.40 to 1.56)	0.19	0.237	0.522	0.545
Wrist-elbow to elbow-shoulder angle (°)	21.04 ± 6.63	20.64 ± 4.18	−0.40 (−2.78 to 1.98)	−0.05	0.734	0.808	0.819
Elbow-shoulder to shoulder-hip angle (°)	157.00 ± 4.85	156.80 ± 3.00	−0.20 (−1.93 to 1.54)	−0.04	0.819	0.819	0.819
Shoulder-hip to hip-knee angle (°)	12.81 ± 1.97	14.75 ± 0.45	1.93 (1.26 to 2.60)	0.92	<0.001	<0.001	<0.001
Hip-knee to knee-ankle angle (°)	19.61 ± 3.53	20.85 ± 2.07	1.24 (−0.16 to 2.64)	0.28	0.082	0.224	0.163
Maximum knee extension angle (°)	2.85 ± 2.26	2.46 ± 1.68	−0.39 (−1.27 to 0.49)	−0.14	0.372	0.585	0.558
Maximum knee flexion angle (°)	52.79 ± 5.30	55.62 ± 4.83	2.83 (0.64 to 5.01)	0.41	0.013	0.069	0.038

Change was calculated as the 3-month value minus the baseline value. Values are presented as mean ± standard deviation and mean change (95% CI). Cohen's dz was calculated as the mean paired change divided by the standard deviation of the paired changes. P values were obtained using two-sided paired t-tests. Overall FDR q values were calculated using the Benjamini–Hochberg procedure across all 11 gait outcomes. Domain-specific FDR adjustment was performed as an exploratory sensitivity analysis within the prespecified spatiotemporal (n = 5) and kinematic (n = 6) domains. Mean changes are expressed in the units shown in the Outcome column; angular changes are expressed in degrees. All analyses

included 40 paired observations (n = 40). P and q values are reported to three decimal places; values <0.001 are reported as <0.001. CI, confidence interval; FDR, false discovery rate.

PRP product characteristics

Cellular enrichment was similar across the three injections (Figure 4). Mean platelet enrichment was 5.16 ± 0.66-, 5.12 ± 0.79-, and 5.35 ± 0.75-fold, respectively. Leukocyte enrichment was 7.75 ± 2.37-, 6.80 ± 2.05-, and 8.12 ± 2.42-fold. Red blood cell ratios were lower at 1.20 ± 0.23, 1.23 ± 0.32, and 1.22 ± 0.33 relative to peripheral blood. On this basis, the preparation was classified as leukocyte-rich, red blood cell-containing PRP.

Safety evaluations

No serious adverse events were reported during the 3-month follow-up. Minor local reactions, including transient injection-site pain or swelling, occurred in 3 participants and resolved spontaneously within 48–72 h without additional intervention.

Discussion

WOMAC and IKDC scores improved 3 months after three PRP injections in patients with mild-to-moderate KOA. The gait results were narrower. Only the shoulder-hip to hip-knee angle remained significant after correction across all 11 outcomes. Maximum knee flexion remained significant only within the kinematic domain, and the change in gait cycle frequency was nominal. Clinical improvement was therefore accompanied by a few gait changes, not a general normalization of walking.

The changes in WOMAC and IKDC scores are broadly consistent with meta-analyses that favored PRP over hyaluronic acid or other intra-articular comparators [7,15,16] and with a prospective study that reported symptomatic improvement [8]. The literature is not uniform. In the RESTORE trial, PRP did not improve pain or medial tibial cartilage volume more than placebo at 12 months [17]. PRP preparations, doses, patient selection, and follow-up periods also vary substantially between studies [18,19]. Given the absence of a control group, our clinical results cannot establish efficacy.

A difference between symptom scores and gait is not unexpected. Pain, perceived function, and biomechanics overlap, but they do not measure the same aspect of KOA. Reported associations between pain and knee biomechanics depend on the variable and study design [20]. Walking mechanics also vary with joint loading, neuromuscular control, task conditions, and the measurement protocol [21]. Patients with similar joint excursions can have different external knee moments [22], and individual moments or angles may relate independently to pain during walking [23]. In this cohort, the clinical response was more evident than the biomechanical response.

The increase in maximum knee flexion may represent less guarded movement in the sagittal plane. Patients with painful KOA may limit knee excursion because of stiffness, pain, or quadriceps-avoidance strategies. Flexion excursion has also been linked to mechanical stress during gait [24]. The meaning of

a larger flexion angle is nevertheless uncertain because joint moments, cadence, and walking speed interact [25]. Walking speed was self-selected, and kinetic loading was not analyzed. The observed change is therefore a kinematic finding, not evidence that knee loading decreased.

The decrease in gait cycle frequency is harder to interpret. It could reflect pacing, continued caution, or differences in self-selected speed between assessments. None of the other spatiotemporal measures changed convincingly, and gait cycle frequency did not remain significant after either FDR correction. Studies designed to examine temporal gait changes should control walking speed or analyze speed and cadence together.

The shoulder-hip to hip-knee angle may reflect a proximal response because compensation in KOA is not confined to the knee [26,27]. A change in this angle could arise from altered coordination of the trunk, pelvis, hip, and knee. However, its clinical meaning and preferred direction are unknown. We did not test measurement reliability or include electromyography, strength testing, or kinetic outcomes. Conventional spatiotemporal measures were also unchanged. This result should remain exploratory.

Pain relief or reduced intra-articular inflammation might allow patients to walk with less guarding, although we did not test that pathway. Aspiration and glucocorticoid injection have been associated with changes in pain and selected gait measures [28], but those findings cannot be transferred directly to PRP. Gait-retraining studies confirm that walking mechanics can change in KOA [29]. If PRP reduces symptoms, it may make movement or rehabilitation easier. These data do not show that an injection alone corrects established gait adaptations.

The PRP contained about five times the platelet concentration of peripheral blood, with greater leukocyte enrichment and modest red blood cell enrichment. It is best described as leukocyte-rich, red blood cell-containing PRP. This detail matters because platelet dose, leukocyte content, activation, and injection schedule differ between studies [18,30]. PRP may affect inflammatory and trophic pathways [6,31], but we did not measure biomarkers, imaging changes, or cellular responses. We therefore cannot link the clinical findings to any specific component of the preparation.

No serious adverse events occurred, and the minor local reactions resolved without treatment. This agrees with the short-term safety findings reported in much of the PRP literature. A recent meta-analysis, however, found more complications after PRP than after placebo, although rates were similar to those after corticosteroid or hyaluronic acid injection [32]. Longer follow-up and consistent adverse-event reporting are warranted for leukocyte-rich preparations.

The prospective design, prespecified assessments, cellular measurements at each injection, and FDR correction are strengths of this study. Together, they allow the PRP product to be described more precisely and reduce the risk of treating nominal gait findings as robust effects.

The main limitation is the absence of a control group. Placebo effects, regression to the mean, natural symptom fluctuation, and changes in activity cannot be separated from a treatment effect. Ten of 50

participants were not included in the 3-month analysis, which may have introduced attrition bias. The follow-up was short, and the single-center cohort included only KL grade I-II disease. The gait analysis was exploratory, used self-selected walking speed, and lacked a sham comparator, reliability testing, and mechanistic measurements. Future trials should use a controlled design, standardized PRP reporting, blinded gait assessment, and longer follow-up.

Conclusion

In patients with mild-to-moderate KOA, WOMAC and IKDC scores improved and a small number of gait variables changed 3 months after three injections of leukocyte-rich, red blood cell-containing PRP. The study does not establish that PRP caused these changes or modified joint structure. Randomized controlled trials with standardized PRP and gait protocols are needed.

Abbreviations

ASIS, anterior superior iliac spine; CI, confidence interval; FDR, false discovery rate; IKDC, International Knee Documentation Committee; KL, Kellgren–Lawrence; KOA, knee osteoarthritis; PRP, platelet-rich plasma; PSIS, posterior superior iliac spine; WOMAC, Western Ontario and McMaster Universities Osteoarthritis Index.

Declarations

Ethics approval and consent to participate

The Ethics Committee of Xuanwu Hospital, Capital Medical University approved the study protocol (approval No. [2024] 011-001). The study was conducted in accordance with the Declaration of Helsinki. All participants provided written informed consent before enrollment.

Consent for publication

Not applicable.

Availability of data and materials

The study protocol and the datasets generated and analyzed during this study are available from the corresponding author on reasonable request, subject to applicable institutional and ethical requirements.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

Yuchen Wang , Hui Feng, and Shuai An contributed equally to this work. Yuchen Wang, Shuai An, and Mingli Feng contributed to the study conception and design. Yuchen Wang, Shuai An, Hui Feng, Hongchen Ren, and Jingbo Cheng contributed to participant recruitment, clinical assessment, intervention implementation, data acquisition, or data interpretation. Yuchen Wang and Shuai An drafted the manuscript. Mingli Feng supervised the study and critically revised the manuscript. All authors reviewed and approved the final manuscript.

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Trial registration

Chinese Clinical Trial Registry, ChiCTR2500099663. Registered 27 March 2025, retrospectively registered.

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Figures

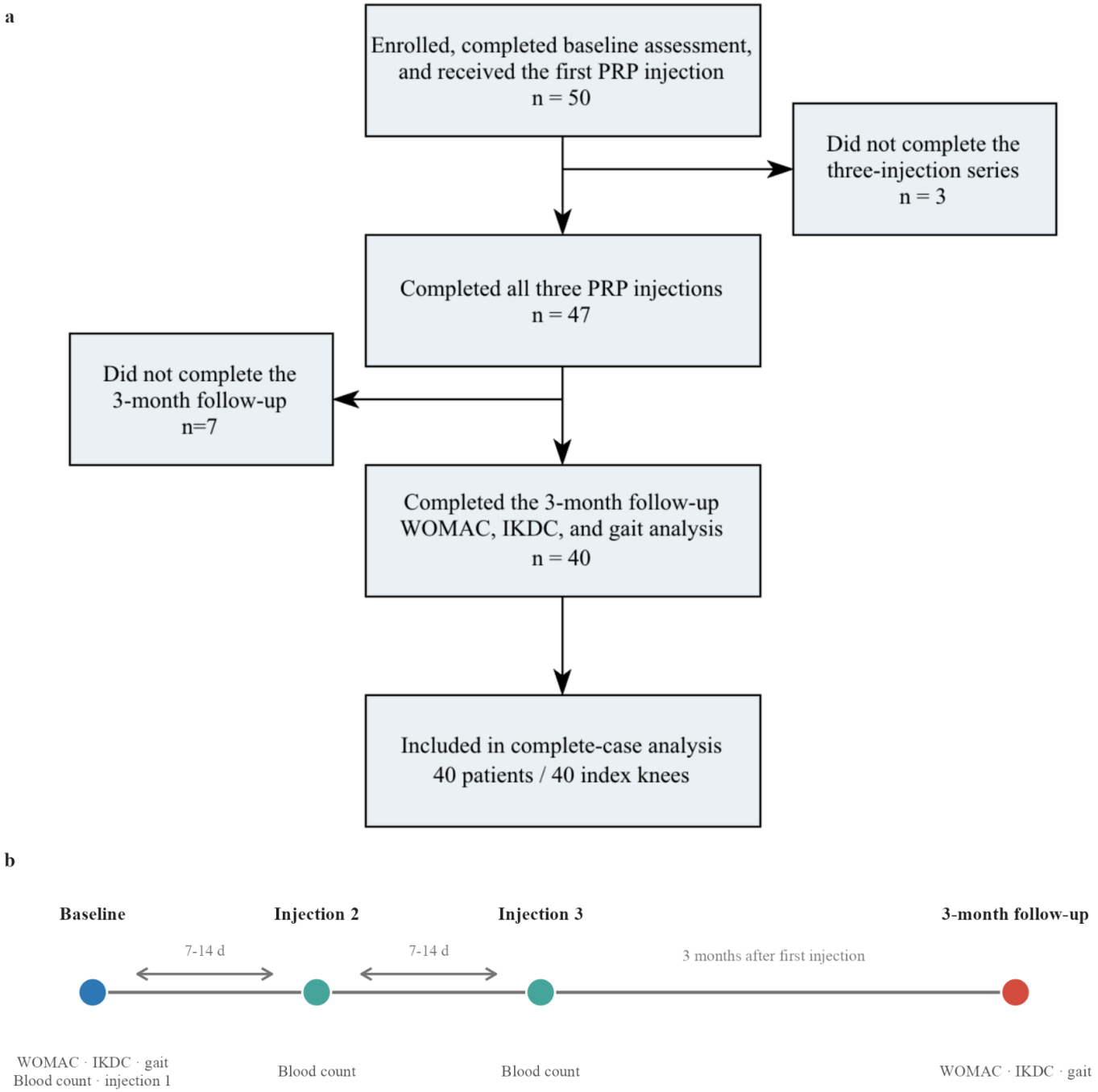


Figure 1

Participant flow and study schedule. a, Of 50 enrolled participants, 47 completed three PRP injections and 40 completed the 3-month follow-up and were included in the analysis. **b,** Clinical and gait assessments were performed at baseline and 3 months, with three PRP injections administered 7–14 days apart. PRP, platelet-rich plasma.

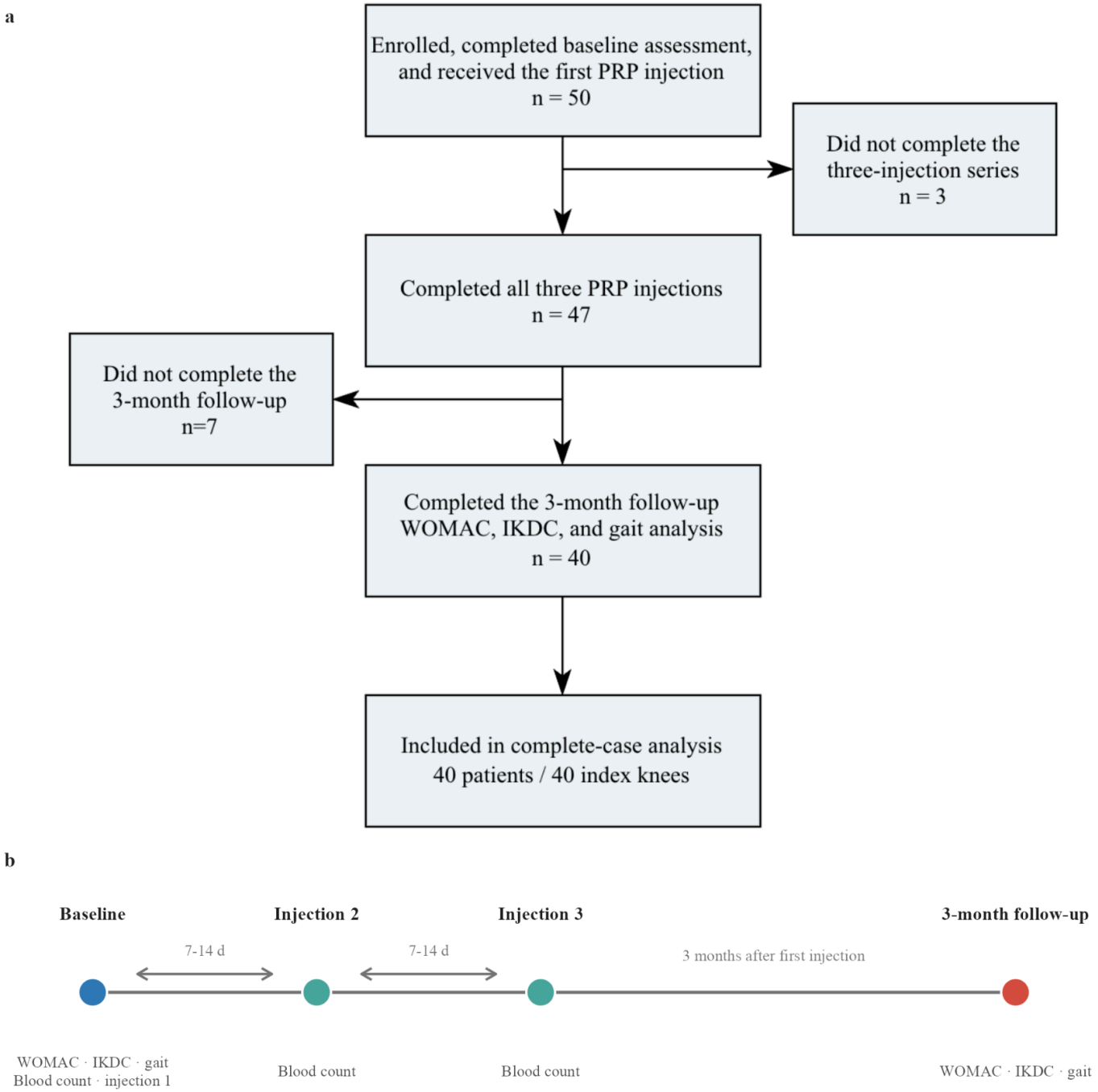


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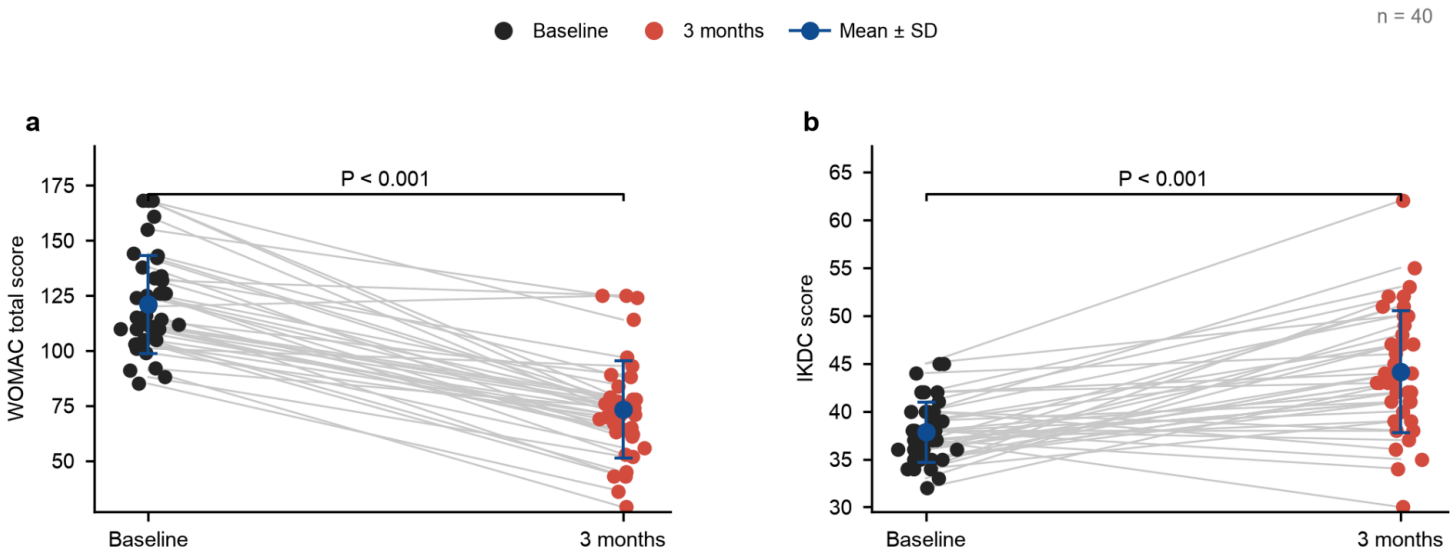


Figure 2

Changes in clinical outcomes after PRP treatment. a, WOMAC total scores at baseline and 3 months. **b,** IKDC scores at baseline and 3 months. Dots represent individual participants, and grey lines connect paired observations. Large circles with error bars indicate mean ± standard deviation. P values were calculated using two-sided paired t-tests; n = 40. Change was defined as the 3-month value minus the baseline value. IKDC, International Knee Documentation Committee; PRP, platelet-rich plasma; WOMAC, Western Ontario and McMaster Universities Osteoarthritis Index.

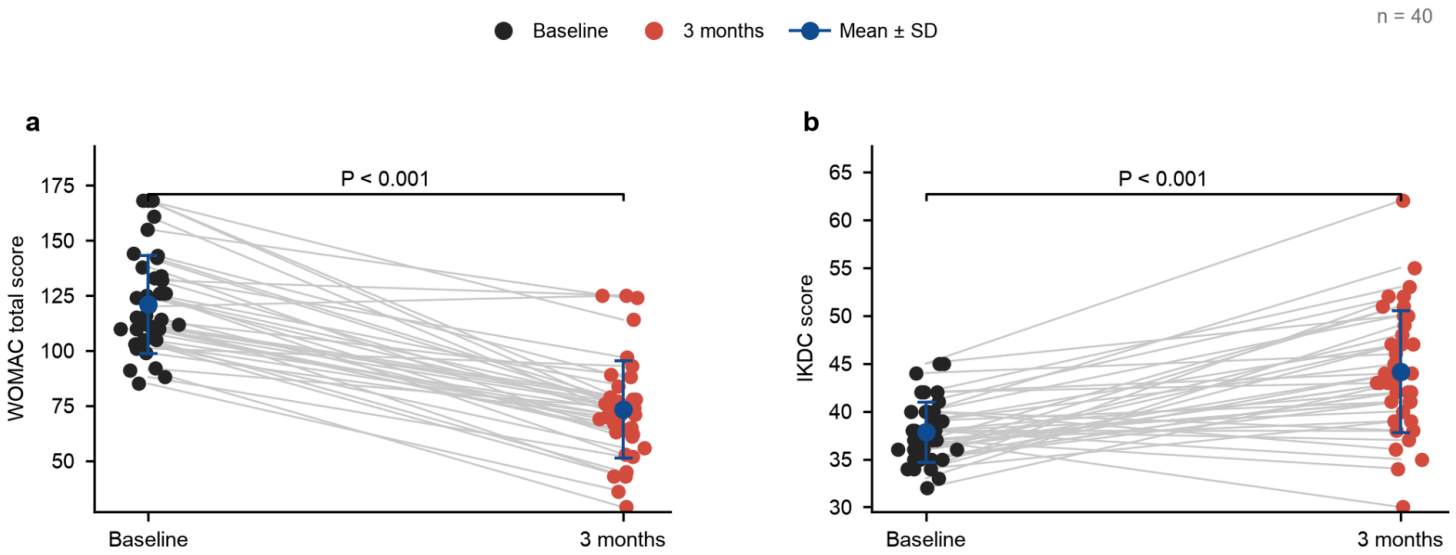


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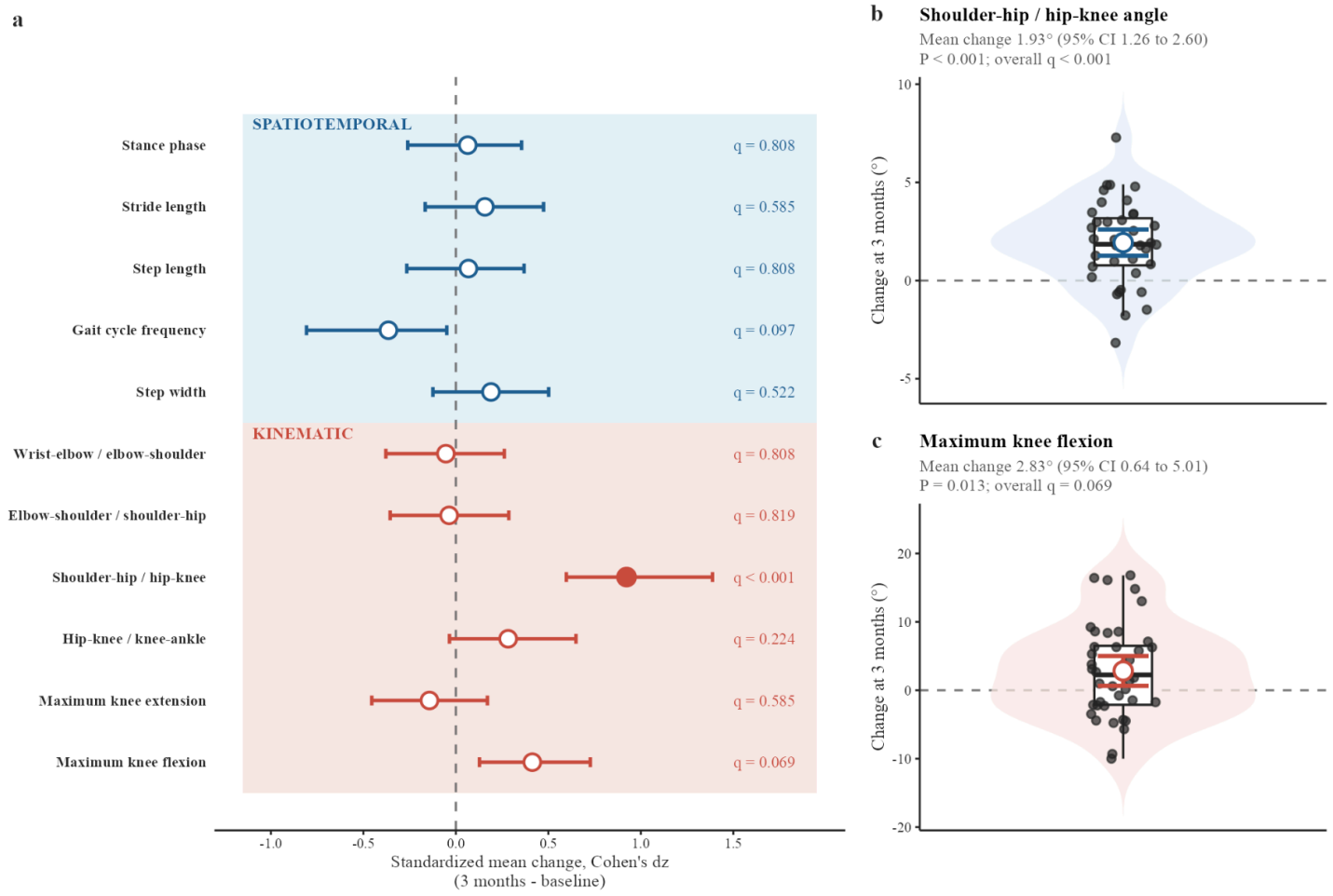


Figure 3

Exploratory changes in gait outcomes from baseline to 3 months after PRP treatment. a, Standardized mean changes in 11 gait outcomes. Blue indicates spatiotemporal outcomes and red indicates kinematic outcomes. Points show Cohen's dz, and error bars show 95% confidence intervals. Overall false discovery rate-adjusted q values are shown on the right. **b,c,** Changes in the shoulder-hip/hip-knee angle and maximum knee flexion, respectively. Dots represent individual index knees, violins show distributions, boxes show medians and interquartile ranges, and open circles with error bars indicate means and 95% confidence intervals. Dashed lines indicate no change; n = 40. FDR correction was applied across all 11 gait outcomes. FDR, false discovery rate; PRP, platelet-rich plasma.

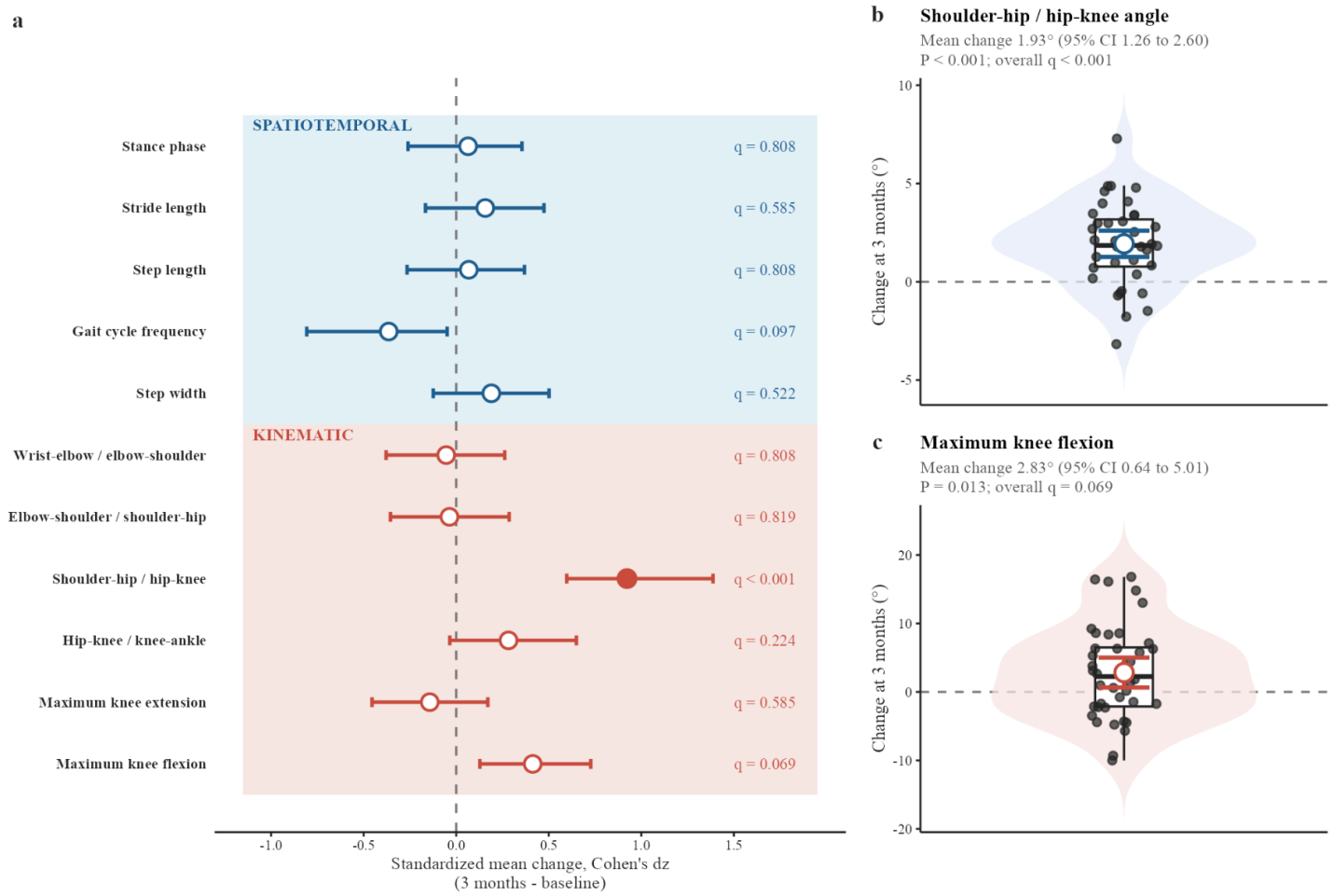


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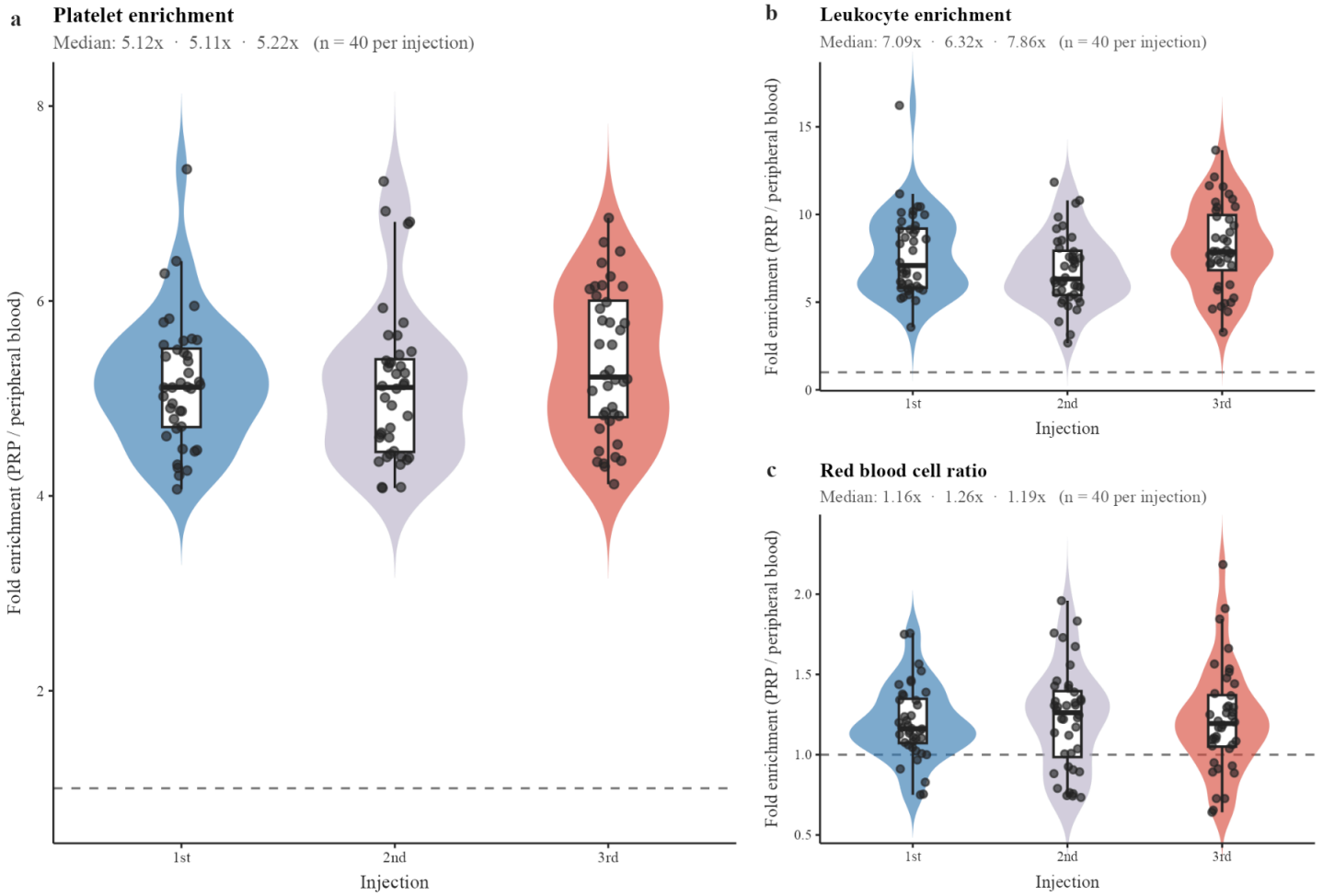


Figure 4

Cellular enrichment of PRP across three injections. **a–c,** Fold enrichment of platelets, leukocytes, and red blood cells in PRP relative to peripheral blood. Dots represent individual samples, violins show distributions, and boxes show medians and interquartile ranges; values displayed above each panel are medians. Dashed lines indicate a ratio of 1, corresponding to no enrichment. Blue, grey, and red indicate the first, second, and third injections, respectively; n = 40 per injection. PRP, platelet-rich plasma.

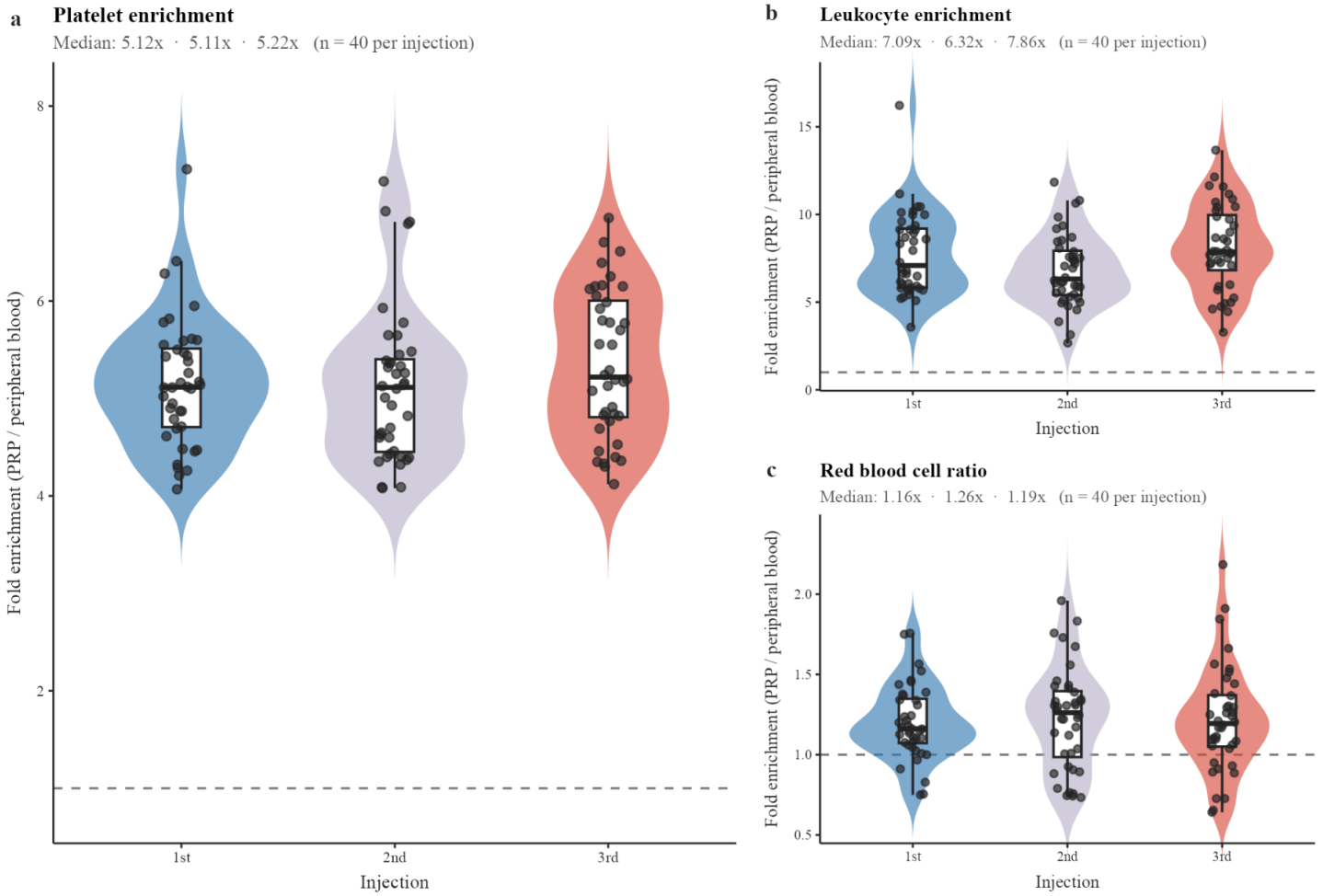


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