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Original Article

The impact of platelet-rich plasma in the short-term management of chronic discogenic pain: A randomized controlled trial

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Abstract

Objective: Platelet-rich plasma (PRP), derived from the patient's own blood and containing a high density of bioactive compounds, is an emerging therapeutic option for the management of spine-related disorders. This study aimed to evaluate the short-term efficacy of PRP therapy in managing chronic discogenic low back pain compared with conventional treatment.

Methods: In the present randomized controlled trial, 32 participants were enrolled from the Neurosurgery Ward at Shahid Bahonar Hospital in Kerman; all patients had a diagnosis of chronic discogenic low back pain. The subjects were randomly assigned to a PRP treatment group ($n=15$) and a control group ($n=17$). PRP was prepared using a standardized protocol and injected into the affected disc under fluoroscopic guidance. Control group participants underwent conventional treatment, specifically physical therapy and analgesics. Pain intensity (VAS), functional disability (ODI), analgesic use, and adverse events were monitored at baseline and at 1, 4, and 12 weeks, and at 6 months post-treatment.

Results: The PRP and control groups had mean ages of 47.5 (±9.2) and 49.8 (±8.8) years, respectively ($P=0.487$). The PRP intervention resulted in significantly improved VAS scores as early as 1 week post-treatment, with improvements persisting at weeks 4 and 12 and at month 6 ($P<0.05$). The PRP group showed greater reductions in ODI scores at both the 12-week and 6-month follow-ups ($P<0.05$).

Conclusion: PRP therapy significantly alleviates pain and improves function in patients with low back pain. This makes it a promising alternative to conventional treatment approaches.

Keywords: Platelet-rich plasma, Blood platelets, Intervertebral disc degeneration, Discopathy, Chronic pain, Low back pain

Introduction

Chronic discogenic pain, stemming from intervertebral disc degeneration, is a common source of discomfort that significantly diminishes daily functioning and well-being due to persistent pain, resulting in disability. This condition often arises from age-related wear and tear of the spinal discs, which results in a breakdown of their normal biochemical makeup, leading to inflammation and nerve irritation (1, 2). Discogenic back pain, originating from the deterioration of spinal discs, represents the most common source of persistent low back pain worldwide, accounting for 26–42% of cases (3). The pathological characteristics observed in the spinal discs of individuals with this type of pain include the development of areas containing new, delicate blood vessels, accompanied by a significant increase in nerve fibers within tears that extend from the outer edge of the annulus fibrosus into the nucleus pulposus. The degeneration of painful discs may stem from an initial injury to the annulus fibrosus, followed by its subsequent repair (3). Traditional management strategies, such as physical therapy, pharmacological treatments, and surgical interventions, like discectomy or spinal fusion, frequently offer limited relief and may introduce side effects or complications (4, 5).

The intervertebral disc consists of a tough outer ring (the annulus fibrosus) and a gel-like core (the nucleus pulposus), which together maintain spinal flexibility and load-bearing capacity. The degenerative process leads to a gradual reduction in the intervertebral space, loss of structural integrity, and changes in the disc's

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biochemical composition, contributing to chronic pain (6, 7). These changes often lead to disc herniation, which irritates surrounding nerve roots and triggers inflammation, exacerbating pain and disability (8). The complexity of discogenic pain underscores the limitations of conventional treatments, which often fail to halt or reverse degenerative processes, prompting exploration into regenerative therapies (9, 10).

Conventional treatments for chronic discogenic pain typically involve analgesics, anti-inflammatory medications (NSAIDs), guided exercise regimens, and, for more serious situations, operative procedures like spinal stabilization or disc removal (1, 9). While these approaches may provide temporary symptom relief, they often do not address the root cause of disc degeneration, leading to persistent pain or recurrence. Additionally, long-term use of analgesics can result in dependency, while surgical interventions carry risks such as infection or reduced spinal mobility (11, 12). Due to the limitations and side effects of conventional treatments, novel approaches such as PRP therapy have emerged as promising alternatives. These regenerative therapies hold promise for addressing the underlying degenerative processes and improving patient outcomes with fewer adverse effects (6).

PRP therapy is an emerging regenerative approach in which a concentration of the patient's own platelets and their associated growth factors—including PDGF, TGF-β, and VEGF—are prepared from a blood sample and injected directly into the damaged spinal disc (13, 14). It is hypothesized that these bioactive proteins promote healing by stimulating disc cell proliferation and collagen (15, 16). PRP injections are generally safe, with most reported side effects mild and transient, such as localized pain, discomfort, or inflammation at the injection site. Significant adverse effects are uncommon, and no consistent major adverse events have been documented in clinical studies (17). While PRP has shown promise in treating musculoskeletal conditions, like tendinopathies and osteoarthritis, its efficacy for discogenic pain remains understudied, with inconsistent results attributed to variations in PRP preparation and patient selection (18, 19). Recent evidence highlights the promising role of PRP therapy in the management of discogenic low back pain. Findings from a randomized controlled trial indicated notable short-term reductions in pain and improvements in functional ability following intradiscal PRP injections, compared with a control group (17). Similarly, a prospective trial reported that nearly half of patients achieved clinically meaningful reductions in pain and disability within 6 months (20). Furthermore, a meta-analysis confirmed consistent pain relief and functional gains at two and six months, supporting PRP therapy as a promising short-term therapeutic option (21). This investigation aimed to assess the short-term effectiveness of PRP treatment compared to conventional treatments, focusing on pain reduction, functional improvement, reduced analgesic use, and safety outcomes.

Methods

This prospective, randomized controlled trial (RCT) enrolled individuals with a confirmed diagnosis of persistent discogenic pain in the Neurosurgery Ward of Shahid Bahonar Hospital, Kerman, in 2021. The study was approved by the ethics committee of Kerman University of Medical Sciences (Ethical code number: IR.KMU.REC.1399.538) and was formally registered with the Iranian Clinical Trials Registry (IRCT) under the code IRCT20210128050164N1. Informed consent was obtained from all participants prior to enrollment. The study adhered to the CONSORT guidelines (22).

The estimated sample size for the two-sample comparison of means was calculated using the following formula, based on data from prior research by Tuakli-Wosornu and colleagues (17). In this calculation, the following parameters were considered: a significance level (α) of 0.05, a β value of 0.10 (equating to 90% statistical power), the standard deviation in the control group (S_1) of 2.12, the standard deviation in the PRP group (S_2) of 2.06, and the minimum clinically important difference (Δ) of 2 points on the VAS. Based on these values, the calculated sample size was 34 individuals, divided equally between the two groups, with 17 subjects assigned to each group. Of the 34 randomized patients, two were lost to follow-up, leaving 32 (PRP: $n=15$; Control: $n=17$) for final analysis.

$$n = \frac{(Z_{1-\alpha/2} + Z_{1-\beta})^2 \times (S_1^2 + S_2^2)}{\Delta^2}$$

Participants were eligible for inclusion if they presented with persistent low back pain originating from degenerative disc disease, with symptoms persisting for at least six months despite conventional treatment. A confirmed diagnosis required a consistent clinical history, physical examination, and supportive neuroimaging. All participants underwent lumbar magnetic resonance imaging (MRI) prior to enrollment to confirm degenerative disc changes consistent with the condition's chronicity. MRI findings were used as supportive criteria to distinguish chronic discogenic pathology from acute conditions. Individuals were excluded if they had significant comorbid conditions, were pregnant, or had contraindications for PRP therapy (Figure 1).

PRP Preparation and Administration

A standardized double-centrifugation method was used to prepare PRP, a technique whose efficiency in concentrating platelets and growth factors crucial for tissue repair has been confirmed (23, 24). The process involved collecting autologous blood from each patient, followed by an initial centrifugation to isolate plasma by removing cellular components, namely red and white blood cells. A second centrifugation step was performed to further concentrate the platelets, yielding a final PRP product rich in biologically active factors that promote healing and reduce inflammation.

Patients in the treatment group received a single

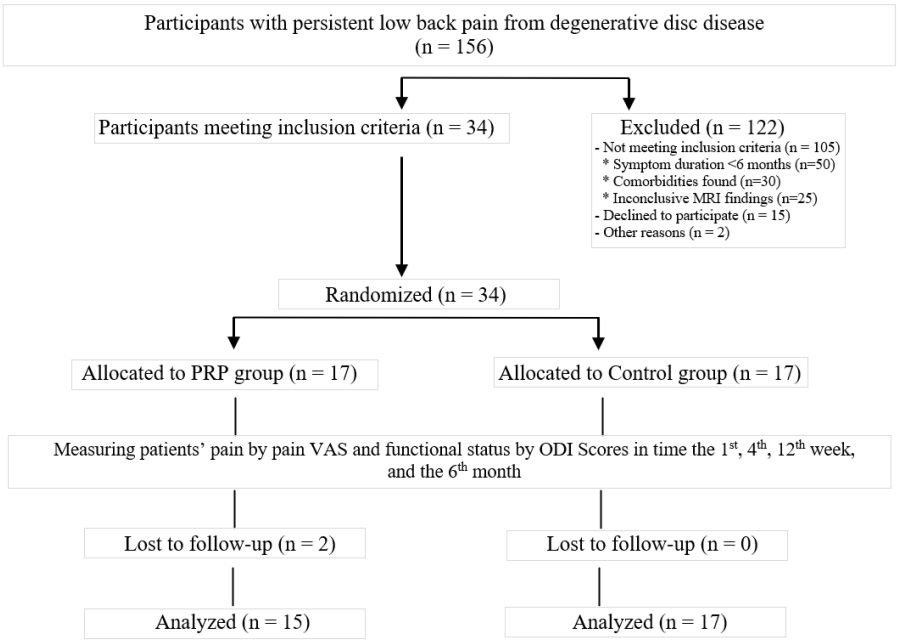

Figure 1. CONSORT flow diagram of clinical trial

intradiscal injection of the prepared platelet-rich plasma. This procedure was performed using fluoroscopic guidance to guarantee precise delivery, aiming to enhance treatment benefits and reduce potential damage to adjacent tissues. All injections were performed under sterile conditions by a trained interventional physician. The control group received conventional management for persistent discogenic pain. The treatment regimen consisted of physical therapy tailored to functional limitations and pain severity, oral analgesics (including NSAIDs), and as-needed muscle relaxants or low-dose opioids (25, 26). This standard treatment aimed to manage symptoms and improve function, though it lacks the regenerative potential attributed to PRP therapy.

Outcome Measures

Pain intensity was evaluated with the Visual Analog Scale (VAS), a widely accepted tool for quantifying self-reported pain. Assessments were conducted at multiple time points to capture changes in pain levels: at baseline (prior to intervention), and at 1 week, 4 weeks, 12 weeks, and 6 months post-intervention. Participants were instructed to mark their pain level on a line from 0 (no pain) to 10 (the most severe pain imaginable), with scores recorded at each follow-up visit.

The assessment of functional improvement was conducted using the Oswestry Disability Index (ODI), a standardized questionnaire that measures the impact of low back pain on a patient's daily activities (27). This instrument examines multiple domains of everyday functioning, including pain severity, self-care, ability to lift objects, mobility, tolerance for sitting and standing, sleep quality, interpersonal relationships, travel, and employment/homemaking. Like the VAS, the ODI was administered at baseline and at each of the designated follow-up points: 1 week, 4 weeks, 12 weeks, and 6 months. This allowed for a comprehensive assessment of each patient's functional improvement over time.

In addition to pain and functional status, analgesic consumption was monitored and recorded during each follow-up visit. Patients were asked to report any pain medications used, enabling evaluation of changes in analgesic dependency following treatment. Furthermore, all adverse events or complications potentially related to the intervention were carefully documented. This included both minor side effects (e.g., local discomfort or transient swelling) and more serious complications (e.g., infection, nerve injury, or worsening of symptoms). The treatment's safety profile was closely monitored throughout the study to ensure the well-being of all participants.

Statistical Analysis

Patient demographic information and initial clinical features were summarized using descriptive statistics. Between-group comparisons for pain reduction, functional improvement, and analgesic use were performed using appropriate statistical tests, including *t*-tests, chi-square tests, and repeated-measures ANOVA. Statistical significance was defined as a P-value < 0.05.

Results

After excluding two patients lost to follow-up, the PRP treatment arm included 15 subjects (mean age 47.5 ± 9.2 years), and the control arm included 17 subjects (mean age 49.8 ± 8.8 years; $P = 0.487$ for age difference). The sample comprised 66.7% males ($n = 10$) in the PRP group and 47.1% males ($n = 8$) in the control group ($P = 0.257$). Initial VAS pain assessments ($P = 0.675$) and Oswestry Disability Index (ODI) scores ($P = 0.621$) showed no significant differences between the two groups at baseline (Table 1).

Baseline VAS scores were comparable across the two treatment groups ($P = 0.680$). However, subjects receiving

PRP showed a markedly greater pain reduction starting from the week 1 follow-up. This statistically significant difference persisted at all subsequent time points: week 1 ($P=0.042$), week 4 ($P=0.009$), week 12 ($P<0.001$), and six months ($P<0.001$), highlighting the sustained and superior analgesic effect of PRP therapy.

Similarly, baseline ODI scores showed no notable difference at the outset of the study ($P=0.689$). While functional ability improved progressively in both groups, patients treated with PRP showed a markedly better improvement in disability scores at later follow-up assessments. The difference between the groups reached statistical significance at the week 12 ($P=0.038$) and 6-month ($P=0.009$) follow-ups, indicating enhanced functional recovery and long-term benefits from the PRP intervention. No significant inter-group differences were found at the 1st week ($P=0.440$) or 4th week ($P=0.223$) assessments (Table 2).

The longitudinal changes in pain intensity (VAS) and functional disability (ODI) for both treatment groups over 6 months visually demonstrate that although both groups started with comparable baseline scores, the PRP group showed a steeper, more pronounced decline in both measures. The trajectories clearly diverge early for pain, with the PRP group showing significantly lower VAS scores from the first week onward. A similar, though delayed, divergence is evident for functional outcomes, where the PRP group's superiority becomes statistically significant from the third-month assessment onward and remains so at the final six-month evaluation. The consistent difference between the two groups indicates a lasting benefit of PRP therapy over the control group in alleviating pain and improving functional capacity (Figure 2).

Pain levels (VAS) decreased significantly over time ($P<0.001$), with a significantly different pattern of change between the PRP and control groups ($P=0.035$). The PRP group reported consistently lower overall pain levels ($P<0.001$). Although disability scores (ODI) also improved significantly over time ($P<0.001$), the pattern of improvement did not differ between groups ($P=0.235$), and no overall group difference was observed ($P=0.066$) (Table 3).

Table 4 summarizes the side effects recorded throughout the trial. Both groups experienced a similar incidence of minor complications, including transient local discomfort and bruising, with no statistically significant differences. Only one case of infection was reported among the control participants. No major complications occurred in either study arm.

Table 1. Participant age, gender, baseline VAS, and ODI scores

Variables		Groups		*P* value
		PRP ($n=15$)	Control ($n=17$)	
Age (years)		47.5±9.2	49.8±8.8	0.487*
Gender	Male	10 (66.7%)	8 (47.1%)	0.257**
	Female	5 (33.3%)	9 (52.9%)	
Baseline VAS Score		7.2±1.1	7.4±1.0	0.675*
Baseline ODI Score		56.4±12.3	58.1±11.8	0.621*

* Independent samples *t*-test.
** Chi-square test

Discussion

In this study, PRP therapy achieved significantly greater pain reduction than standard treatment and was

Table 2. Comparison of pain intensity (VAS) and functional disability (ODI) scores between the treatment and control groups following the intervention

Variables	VAS Scores		*P* value*	ODI Scores		*P* value*
	PRP	Control		PRP	Control	
Baseline	7.2±1.1	7.4±1.0	0.680	56.4±12.3	58.1±11.5	0.689
1st week	5.1±1.1	6.0±1.2	0.042	47.3±10.1	50.4±11.6	0.440
4th week	4.2±0.9	5.2±1.1	0.009	41.2±9.5	45.8±11.1	0.223
12th week	3.5±0.8	4.8±1.0	<0.001	34.7±8.3	41.7±9.8	0.038
6th month	3.0±0.7	4.5±1.1	<0.001	32.8±6.2	39.2±6.6	0.009

* Independent samples *t*-test.

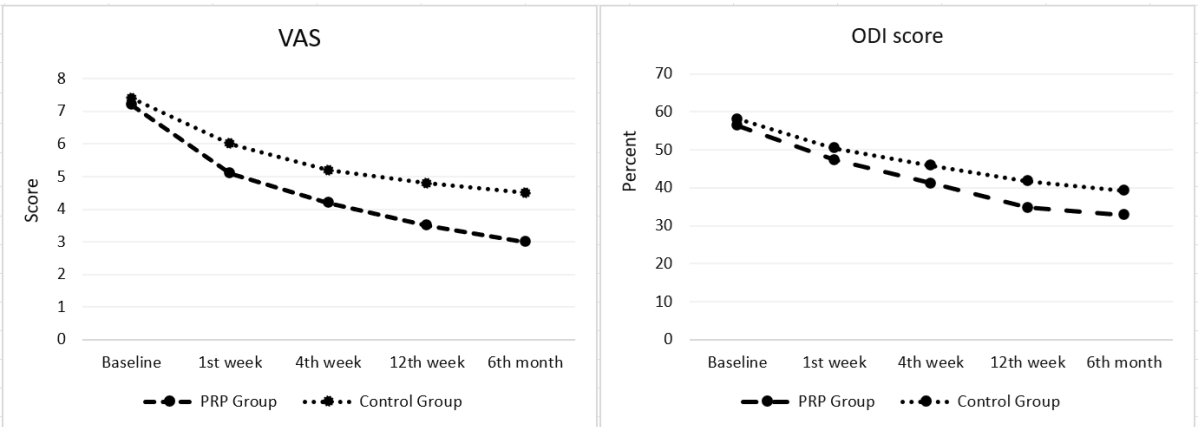

Figure 2. Trend of VAS and ODI scores over time in the PRP and control groups

Table 3. Results of repeated-measures ANOVA for VAS scores and ODI scores across time by group

Variable	VAS Scores				ODI Scores			
Source	**SS***	***df***	***F***	***P* value**	**SS***	***df***	***F***	***P* value**
Time	251.719	2.767	90.730	<0.001	9353.758	1.772	86.010	<0.001
Time × Group	8.594	2.767	3.097	0.035	162.357	1.772	1.493	0.235
Group	37.081	1	16.831	<0.001	822.464	1	2.134	0.066

* Sum of squares

Table 4. Comparison of adverse event rates in the PRP and control groups

Adverse Event	Groups		*P* value*
	PRP (*n*=15)	Control (*n*=17)	
Local Discomfort (yes)	3 (20.0%)	4 (23.5%)	0.576
Bruising (yes)	2 (13.3%)	3 (17.6%)	0.563
Infection (yes)	0 (0%)	1 (5.9%)	0.531

* Fisher's Exact test

consistently associated with reduced analgesic use across all follow-up assessments. Results clearly demonstrate faster and more sustained pain relief in the PRP group, with the most notable improvements observed in the early weeks post-treatment. Tuakli-Wosornu et al. demonstrated that participants receiving PRP achieved notably better outcomes on the Functional Rating Index (FRI), the Numeric Rating Scale (NRS) for their lowest pain levels, and patient satisfaction scores relative to those in the control group. These functional improvements were maintained for at least 1 year after the intervention, indicating the potential long-term benefits of PRP treatment for pain originating from degenerative discs (17). A study by Navani et al. examined the efficacy and safety profile of orthobiologic treatments—specifically PRP combined with bone marrow concentrate (BMC)—in patients with chronic pain due to disc degeneration. The results indicated that both PRP and BMC led to substantial reductions in pain and improvements in functional capabilities over the follow-up period (28). A synthesis of existing research evaluating the efficacy of platelet-rich plasma injections for treating chronic low back pain indicated that approximately 85% of the included studies reported positive results, including reduced pain and improved function compared with control groups. Although a minority of studies did not demonstrate statistically significant differences, the overall evidence supports the potential benefits of PRP therapy for alleviating symptoms and improving function in individuals suffering from this condition (29). Another investigation revealed that after a brief period (4 weeks), corticosteroids were the most effective treatment for alleviating pain and enhancing function in individuals with persistent low back pain. At 3 months, radiofrequency (RF) therapy became the most effective, followed by PRP, corticosteroids, and lidocaine. By 6 months, RF remained the top option, closely followed by PRP. However, while RF showed a slight decline in effectiveness over time, PRP continued to improve, suggesting that PRP may offer more sustained benefits in disability reduction during longer follow-up (30).

The study findings indicated that functional outcomes improved more significantly in patients receiving platelet-rich plasma, with the most notable gains observed at 3 and 6 months. Machado et al. found that PRP injections, compared with placebo, led to clinically meaningful improvements in functional outcomes and higher patient satisfaction (29). Long-term follow-up (5 to 7 years) of patients treated with PRP for symptomatic degenerative intervertebral discs demonstrated that individuals receiving PRP continued to experience substantial reduction in pain and functional improvement over a multi-year period following the initial treatment (31). In a study by Akeda et al., patients treated with PRP demonstrated markedly better progress on disability metrics at the six-month mark and superior gains in walking capacity at the one- and two-month intervals compared with the corticosteroid group. PRP treatment also resulted in sustained reduction in pain, better functional outcomes, and a higher perceived quality of life over a 60-week follow-up period (32).

The application of PRP in this investigation yielded considerable benefits in terms of pain relief, reduced need for analgesics, and improved functional performance among individuals suffering from persistent discogenic pain. Compared to the control group, patients receiving PRP exhibited a more rapid and persistent improvement in both pain and disability indices, particularly evident by the 12th week and continuing through the 6-month follow-up. These clinical effects can be attributed to PRP's biological mechanisms. PRP contains a high concentration of autologous bioactive proteins, including platelet-derived growth factor (PDGF), transforming growth factor-beta (TGF-β), and vascular endothelial growth factor (VEGF) (32, 33). These molecules promote tissue healing, modulate inflammation, and support angiogenesis, all of which are critical in disc regeneration and pain reduction.

Additionally, PRP's anti-inflammatory effects help downregulate pro-inflammatory cytokines such as IL-1β and TNF-α, contributing to its analgesic properties and its improvement of functional outcomes (34). These mechanisms align with the observed sustained improvement in pain and reduced dependency on analgesics in our study. While the study provides promising results, the generalizability of the findings is constrained by the limited number of participants and the relatively brief observation window. Subsequent investigations should involve a larger number of subjects

and extended monitoring periods to confirm these findings and assess the persistence of PRP's therapeutic effects. Moreover, standardizing PRP preparation and injection techniques will be crucial for comparing results across different studies.

Conclusion

PRP therapy shows significant short-term efficacy in managing chronic discogenic pain, offering superior pain reduction and functional improvement compared to conventional treatments. Its favorable safety profile and reduced need for analgesics further enhance its appeal as an alternative treatment option.

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Visualization: Reza Goujani.
Writing–original draft: Reza Goujani, Vahid Tavakolian-Ferdousie.

Competing Interests

The authors declare that they have no known competing financial interests or personal relationships that could have influenced the work reported in this paper.

Ethical Approval

The study protocol received approval from the Ethics Committee of Kerman University of Medical Sciences and was conducted in accordance with the approved guidelines (Ethical code: IR.KMU.REC.1399.538). Written informed consent was obtained from all patients or their legal guardians prior to enrollment.

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