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Feasibility, Safety, and Clinical Outcomes of a Multi-Target Platelet-Rich Plasma Injection Protocol for Chronic Low Back Pain: A Prospective Single-Arm Pilot Study

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Abstract

Background

Chronic low back pain (LBP) is often multifactorial, with overlapping discogenic, facetogenic, and myofascial pain generators. While platelet-rich plasma (PRP) has shown promise in selected spinal pain conditions, most published protocols target a single anatomical source, failing to reflect the complex, mixed-pathology presentations seen in routine clinical practice.

Methods

In this prospective single-arm pilot study, 29 patients with chronic LBP refractory to conservative therapy underwent a single-session, fluoroscopy-guided administration of autologous PRP to the interlaminar epidural space, affected facet joints, and paraspinal trigger points. Outcomes were assessed using the Numeric Pain Scale (NPS), Oswestry Disability Index (ODI), and Single Assessment Numeric Evaluation (SANE) and sequentially at baseline and at 1 week, 1 month, 3 months, and 6 months after the procedure.

Results

Improvements were observed across all three outcome measures over the 6-month follow-up period. Mean NPS decreased from 7.66 ± 1.27 at baseline to 4.76 ± 2.79 at 6 months ($p < 0.001$). Mean ODI improved from 20.45 ± 7.95 to 12.38 ± 9.02 ($p < 0.001$), and mean SANE increased from 0.53 ± 0.16 to 0.69 ± 0.21 ($p < 0.001$). The largest gains were observed between 1 and 3 months. No serious adverse events were reported.

Conclusion

This pilot study suggests that a multi-target PRP injection protocol is feasible, well-tolerated, and associated with significant longitudinal improvement in pain and function in patients with chronic multifactorial LBP. The biphasic recovery timeline observed suggests a genuine biological effect beyond placebo, though causal efficacy cannot be definitively established without a control arm. These preliminary findings support the need for large-scale randomized controlled trials to evaluate this comprehensive regenerative approach.

Introduction

Low back pain is a major global health problem and a leading cause of disability. Its clinical presentation is often multifactorial, with intervertebral disc disease, facet arthropathy, and paraspinal muscular dysfunction frequently coexisting in the same patient (1)(2)(3)(4)(5)(6)(7). Current management includes medications, physical therapy, behavioral interventions, and image-guided procedures; however, durable benefit remains inconsistent for many patients, especially those with chronic symptoms and mixed pain generators (8).

Platelet-rich plasma (PRP) is an autologous orthobiologic therapy derived from peripheral blood and enriched with platelets and bioactive proteins. PRP has been studied across multiple musculoskeletal conditions because of its potential to modulate inflammation and support tissue repair (9)(10)(11)(12). In spinal pain, however, the literature remains heterogeneous because of variability in PRP preparation, leukocyte content, injectate volume, target selection, and outcome assessment. As a result, cross-study comparison is difficult and the clinical role of PRP in low back pain remains incompletely defined (8)(10)(13).

Most published PRP studies in low back pain have targeted a single anatomical source, such as the epidural space or the facet joint (2)(12)(14)(15)(16)(17). In routine practice, however, many patients present with overlapping discogenic, facet-mediated, and myofascial pain contributors. Treating only one presumed pain generator may therefore underestimate the complexity of the condition. To address this real-world challenge, we evaluated a bundled multi-target protocol, termed “PRP Spinoplasty,” in which PRP is administered to the epidural space, affected facet joints, and paraspinal trigger points during the same session. Rather than testing a single isolated mechanism, this approach was designed as a pragmatic intervention for multifactorial chronic LBP.

Despite growing interest in PRP for spinal pain, most studies isolate a single anatomical target, which may not reflect the multifactorial nature of chronic low back pain. Consequently, the effectiveness of a multi-target, clinically pragmatic PRP approach remains largely unexplored.

The objective of this pilot study was to assess the feasibility, safety, and clinical outcomes associated with PRP Spinoplasty in patients with chronic low back pain related to lumbar disc disease and facet arthropathy with associated muscular spasm. Secondary aims were to describe the trajectory of change in pain, disability, and patient-reported overall status over 6 months and to explore whether selected demographic and clinical variables were associated with differential response.

Materials and Methods

Study Design and Setting

This was a prospective single-arm pilot study designed to assess feasibility, safety, and longitudinal clinical outcomes associated with a bundled multi-target PRP injection protocol and was not powered to determine efficacy. Because of the absence of a comparator arm, the study was not designed to establish causal efficacy. The protocol was approved by a local Institutional Review Board (IRB). This study was registered retrospectively at ClinicalTrials.gov (Identifier: NCT07268885) on November 14, 2025. The study was initiated prior to registration due to administrative oversight. The authors confirm that all

ongoing and related trials for this intervention are registered. No formal a priori feasibility endpoints (e.g., predefined recruitment or retention thresholds) were established. Feasibility was assessed descriptively based on recruitment rates, procedural completion, and follow-up adherence. All methods were performed in accordance with the relevant guidelines and regulations, including the Declaration of Helsinki and applicable institutional standards.

Patients were recruited consecutively from a single private interventional pain practice. Of the 35 patients initially enrolled, four were lost to follow-up despite repeated contact attempts, and two were excluded from the final analysis after receiving corticosteroid injections during follow-up. The first was a 65-year-old woman with moderately severe stenosis who required early symptom relief. The second received a steroid injection at an outside facility and later requested a facet steroid injection. A total of 29 patients completed the 6-month follow-up and were included in the per-protocol analysis.

The study population consisted of adult patients with chronic low back pain attributed to lumbar disc disease and facet arthropathy, with an associated muscular spasm component. Diagnoses were established by an interventional pain specialist on the basis of clinical history, physical examination, and lumbar magnetic resonance imaging (MRI).

To ensure a rigorous evaluation of the intervention, strict inclusion and exclusion criteria were applied. Eligible participants included adults aged 18 to 80 years presenting with low back pain clinically consistent with lumbosacral radicular, facet-mediated, and myofascial components, supported by MRI-confirmed lumbar pathology involving disc disease and/or facet arthropathy. Furthermore, patients were required to have failed at least 3 months of conservative therapy, including nonsteroidal anti-inflammatory drugs (NSAIDs) and physical therapy, and present with a baseline pain score of 6 or higher on the 10-point Numeric Pain Scale (NPS). Patients were excluded if they presented with local or systemic infection, cancer diagnosed within the previous 12 months, or an inability to provide informed consent. Additional exclusion criteria included spinal deformities such as fractures, severe spinal stenosis with neurological deficits, lower-extremity weakness or urinary symptoms attributable to spinal pathology, and any previous decompression or fusion surgery at the treatment level. To isolate the biological effects of the PRP, patients were excluded if they had received any spine injection within the previous 12 months, used NSAIDs within 2 weeks before or 6 weeks after the procedure, or used corticosteroids within 6 weeks before or after the procedure. Finally, individuals using anticoagulants or antiplatelet drugs (except low-dose aspirin), those with a history of blood disorders, or those who had undergone major surgery within the previous 3 months were also excluded.

Study Variables and Intervention

The primary outcomes were changes in pain, disability, and patient-rated global improvement as measured by the NPS, ODI, and SANE instruments. The principal exposure was the PRP Spinoplasty procedure. Exploratory covariates included age, sex, body mass index (BMI), educational level, occupational category, and duration of pain.

Written informed consent was obtained from all participants before enrollment after discussion of the study purpose, procedure, potential risks, expected post-procedural course, and alternatives. Patient data were coded and stored securely with access limited to the research team.

Each participant underwent a single-session PRP Spinoplasty procedure consisting of PRP preparation followed by a fluoroscopy-guided multi-target injection sequence. The intervention should be interpreted as a bundled pragmatic protocol rather than a standardized single-target PRP efficacy test.

PRP Preparation

With the patient in the supine position, the cubital fossa was prepared aseptically. Using a 20-gauge butterfly needle, 180 mL of whole blood was collected into three 60-mL syringes, each prefilled with 6 mL of anticoagulant citrate dextrose solution A (ACD-A). The blood was then processed under sterile conditions in a laminar flow hood and transferred into six 50-mL conical tubes for centrifugation according to a proprietary double-spin protocol. The final product was a leukocyte-poor PRP preparation based on the intended processing method.

The PRP used in this study was prepared using an open, double-spin centrifugation technique in our laboratory. This method consistently produces a high-concentration PRP formulation, achieving approximately 5–8-fold platelet enrichment relative to baseline whole blood levels. Absolute platelet counts and leukocyte concentrations were directly quantified for each sample, confirming both the degree of platelet enrichment and the reduction in white blood cell content. Platelet recovery rates are maintained in the moderate-to-high range, typically between 65–95%, reflecting efficient capture of circulating platelets. The system is designed to generate leukocyte-poor PRP, with substantial reduction in total white blood cell content and near-complete depletion of granulocytes, the primary mediators of inflammatory and catabolic responses. This results in a reproducible, low-inflammatory PRP profile that balances biologic potency with cellular purity. The characteristics of this preparation make it particularly suitable for regenerative spinal applications, where minimizing inflammatory response is critical to therapeutic outcomes.

High platelet concentration and efficient platelet recovery are recognized as key determinants of PRP biologic potency, with prior studies demonstrating that increased platelet dose is associated with enhanced regenerative potential and improved clinical outcomes, particularly when combined with reduced leukocyte and granulocyte content to minimize inflammatory effects (18)(19)(20). Before injection, PRP was mixed with 0.5% ropivacaine in a ratio of 3 mL PRP to 1 mL ropivacaine.

Injection Procedure and Post-Intervention Management

The patient was placed prone on the fluoroscopy table. The lumbosacral region was prepared with antiseptic solution and draped in sterile fashion. The skin and subcutaneous tissues at the planned entry sites were anesthetized with 1% lidocaine. Under fluoroscopic guidance, the PRP-ropivacaine mixture was

then delivered to three anatomical targets in a continuous, single-session sequence. First, an 18-gauge, 3.5-inch Tuohy needle was advanced into the interlaminar epidural space at the primary level of pathology using the loss-of-resistance technique. After confirmation of position, 6 mL of the mixture was injected under live fluoroscopy. Next, a 22-gauge, 3.5-inch spinal needle was used to target the affected facet joints bilaterally. After fluoroscopic confirmation, 0.5 mL was injected intra-articularly and 2 mL around the joint capsule and dorsal medial branch region. Finally, the paraspinal muscles in the symptomatic area were injected at multiple trigger-point sites using a 25-gauge, 1.5-inch needle, with approximately 1.0 mL of the mixture delivered per site. After completion of the procedure, the skin was cleaned and sterile dressings were applied. After the procedure, patients were observed for 2 hours and advised to rest relatively for 48 hours, followed by a gradual return to usual activities. Acetaminophen or a muscle relaxant was permitted as needed for post-procedural discomfort, but patients were strictly instructed to avoid NSAIDs and corticosteroids for 6 weeks so as not to interfere with the intended inflammatory cascade associated with PRP. A formal physical therapy program was not mandated by the study protocol. The volume of PRP administered in this study was standardized according to the injection site, with 6 mL delivered via the interlaminar epidural route, and 8 mL administered for both facet joint and trigger point injections.

Outcome Measures

Outcomes were assessed at baseline and at 1 week, 1 month, 3 months, and 6 months after the procedure. Baseline data were collected face-to-face by a neurologist/interventional pain specialist. Follow-up data were collected either by telephone interview or in person. The primary endpoint for this pilot analysis was change in NPS, ODI, and SANE from baseline to 6 months. All three instruments were available in Arabic and had been translated and validated for local use (15)(16)(17). The Numeric Pain Scale (NPS) utilized and 11-point scale from 0 (no pain) to 10 (worst imaginable pain) used to quantify pain intensity (21). The Oswestry Disability Index (ODI) comprised a 10-item questionnaire assessing low back pain-related disability, categorized into raw score ranges indicating no disability to complete disability (22). The Single Assessment Numeric Evaluation (SANE) served as a patient-reported global assessment, rating current condition as a percentage of normal from 0 to 100%. Adverse events were monitored systematically at each follow-up contact using a standardized checklist regarding severe post-procedural pain, fever, erythema, swelling, new or worsening neurological symptoms, hospital visits, or other unexpected medical events.

Safety Assessment

Adverse events were monitored systematically at each follow-up contact. Patients were questioned using a standardized checklist regarding severe post-procedural pain, fever, erythema, swelling, new or worsening neurological symptoms, hospital visits, or other unexpected medical events.

Data Analysis

All statistical analyses were performed using IBM SPSS Statistics for Windows, version 25.0. The analysis was conducted on a per-protocol basis for the 29 patients who completed the 6-month follow-up. Assumptions for parametric testing, including approximate normality, were checked before analysis. A p value of less than 0.05 was considered statistically significant.

Descriptive statistics were used to summarize demographic and baseline characteristics. Categorical variables are presented as frequencies and percentages, and continuous variables as means and standard deviations.

The primary exploratory analysis used paired-samples t tests to compare baseline scores with each follow-up time point for NPS, SANE, and ODI, as well as changes between consecutive follow-up intervals. Because the study involved repeated longitudinal measurements in a small cohort, these analyses should be interpreted as exploratory. A repeated-measures model or linear mixed-effects approach would provide a more robust framework for future studies with larger samples and less missing data.

Secondary analyses explored whether selected demographic and clinical factors were associated with 3-month change scores. Independent-samples t tests were used for binary subgroup comparisons, and one-way analysis of variance (ANOVA) for multi-category variables.

Results

Twenty-nine patients completed the 6-month follow-up and were included in the final analysis. Females comprised 58.6% of the cohort and males 41.4%. The mean age was 42.59 ± 4.68 years and the mean BMI was 28.58 ± 4.67 kg/m². Additional baseline demographic and clinical characteristics are summarized in Table 1.

Table 1
Demographic and baseline characteristics of the study population.

Variable	Sub Variable	Number	%
Sex	Male	12	41.4
	Female	17	58.6
Job	Low intensity	13	44.8
	Moderate intensity	10	34.5
	High intensity	6	20.7
Education level	School	15	51.7
	Bachelors	9	31.0
	MSc	5	17.2
Age in years	$\leq$ 42 years	10	34.5
	> 42 years	19	65.5
BMI	< 30	22	75.9
	$\geq$ 30	7	24.1
Duration of back pain	< 5 years	17	58.6
	≥ 5 years	12	41.4
Age	Mean $\pm$ SD	42.59 $\pm$ 4.68	
BMI	Mean $\pm$ SD	28.58 $\pm$ 4.67	

Mean NPS decreased from 7.66 ± 1.27 at baseline to 5.79 ± 2.16 at 1 week, 6.07 ± 2.46 at 1 month, 4.38 ± 2.44 at 3 months, and 4.76 ± 2.79 at 6 months. Compared with baseline, these changes were statistically significant at all follow-up time points. The largest reduction occurred between 1 and 3 months. Because there was no control group, these observations should be interpreted as within-patient improvement over time rather than proof of treatment efficacy.

Pairwise comparisons showed no significant difference between 1 week and 1 month (p = 0.46), a significant additional improvement from 1 month to 3 months (p = 0.001), and no significant change between 3 and 6 months (p = 0.35), suggesting early change followed by stabilization. Detailed results are presented in Table 2 and Fig. 1.

Table 2
Changes in NPS scores over time relative to baseline and the immediately preceding follow-up interval.

Time Point of NPS	Compared with Pre-Injection		Compared with the immediately preceding time point	
	Mean ± SD	p-Value	Mean ± SD	p-Value
Pre-injection	7.66 ± 1.27	- -	- -	- -
1 Week Post Injection	5.79 ± 2.16	< 0.001	1.±1.68	< 0.001
1 Month Post Injection	6.07 ± 2.46	< 0.001	-0.28 ± 1.99	0.46
3 Months Post Injection	4.38 ± 2.44	< 0.001	1.69 ± 2.36	0.001
6 Months Post Injection	4.76 ± 2.79	< 0.001	-0.38 ± 2.14	0.35

Mean SANE improved from 0.53 ± 0.16 at baseline to 0.62 ± 0.14 at 1 week, 0.63 ± 0.17 at 1 month, 0.71 ± 0.18 at 3 months, and 0.69 ± 0.21 at 6 months. Improvements from baseline were statistically significant at all follow-up assessments. Similar to NPS, the largest gain was observed between 1 and 3 months. Full SANE results are shown in Table 3 and Fig. 2.

Table 3
Changes in SANE scores over time relative to baseline and the immediately preceding follow-up interval.

Time Point of SANE	Compared with Pre-Injection		Compared with the immediately preceding time point	
	Mean ± SD	p-Value	Mean ± SD	p-Value
Pre-injection	0.53 ± 0.16			
1 Week Post Injection	0.62 ± 0.14	0.01	-0.09 ± 0.18	0.01
1 Month Post Injection	0.63 ± 0.17	0.003	-0.01 ± 0.15	0.67
3 Months Post Injection	0.71 ± 0.18	0.001	-0.08 ± 0.17	0.02
6 Months Post Injection	0.69 ± 0.21	0.001	0.02 ± 0.15	0.46

Mean ODI improved from 20.45 ± 7.95 at baseline to 18.48 ± 9.31 at 1 week, 17.66 ± 8.83 at 1 month, 12.07 ± 7.50 at 3 months, and 12.38 ± 9.02 at 6 months. The early changes at 1 week and 1 month did not reach statistical significance, whereas the 3-month and 6-month improvements were significant. These findings indicate that pain reduction preceded clearly measurable functional gains. Detailed ODI results are presented in Table 4 and Fig. 3.

Table 4
Changes in ODI scores over time relative to baseline and the immediately preceding follow-up interval.

Time Point of Oswestry	Compared with Pre-Injection		Compared with the immediately preceding time point	
	Mean ± SD	p-Value	Mean ± SD	p-Value
Pre-injection	20.45 ± 7.95			
1 Week Post Injection	18.48 ± 9.31	0.123	1.97 ± 6.65	0.123
1 Month Post Injection	17.66 ± 8.83	0.066	0.83 ± 6.59	0.50
3 Months Post Injection	12.07 ± 7.50	0.001	5.59 ± 1.32	0.001
6 Months Post Injection	12.38 ± 9.02	0.001	-0.31 ± 6.41	0.80

Exploratory subgroup analyses did not identify statistically significant differences in 3-month change scores according to sex, age, BMI, occupation, education level, or pain duration. Given the small sample size, these negative findings should be interpreted cautiously because the study was underpowered to detect modest subgroup effects. Results are summarized in Table 5.

Table 5
Exploratory subgroup analyses of change in NPS, SANE, and ODI from baseline to 3 months.

Variable		n	NPS			SANE			OSWESTRY		
			Mean	T/F	P value	Mean	T/F	P value	Mean	T	P value
Sex	male	12	-3.5	-0.50	0.67	0.13	-1.4	0.18	-5.9	1.3	0.20
	female	17	-3.1			0.22			-10.1		
Age	$\leq$ 42	10	-2.90	0.63	0.53	0.17	-0.23	0.82	-5.40	1.38	0.18
	> 42	19	-3.47			0.18			-9.95		
BMI	< 30	22	-3.63	-1.53	0.14	0.20	0.73	0.47	-8.09	0.32	0.76
	$\geq$ 30	7	-2.15			0.14			-9.29		
Job	Low	13	-3.23	0.005	0.995	0.21	0.325	0.725	-10.92	1.225	0.310
	Moderate	10	-3.30			0.17			-7.30		
	High	6	-3.33			0.14			-4.67		
Education	School	15	-3.27	0.005	0.995	0.16	2.028	0.152	-8.93	1.294	0.291
	Bachelors	9	-3.33			0.27			-10.44		
	MSc	5	-3.20			0.08			-3.0		
Duration of back pain	< 5 years	17	-3.65	-1.04	0.31	0.22	1.38	0.18	-6.82	1.17	0.25
	≥ 5 years	12	-2.75			0.13			-10.58		

Adverse Events

No serious adverse events, including infection, new neurological deficits, or hospitalization, were reported during the 6-month follow-up. A subset of patients experienced mild-to-moderate localized post-injection pain or transient stiffness that generally resolved within 48 to 72 hours and rarely persisted beyond 5 to 7 days. Symptoms were managed with acetaminophen in accordance with the post-procedural protocol.

Discussion

This prospective single-arm pilot study evaluated a novel bundled multi-target PRP protocol for chronic multifactorial low back pain. Over 6 months, participants showed improvement in pain intensity, disability, and global self-rated status. These findings support the feasibility and tolerability of the protocol and provide preliminary effect-size estimates for future trials. However, because the study lacked a control group, randomization, and blinding, the observed changes cannot be interpreted as proof of causal efficacy.

A central feature of the Spinoplasty protocol is its pragmatic multi-target design. Chronic low back pain is rarely attributable to a single pain generator, and many patients have overlapping discogenic, facet-mediated, and myofascial contributors. Delivering the intervention to the epidural space, affected facet joints, and paraspinal trigger points was intended to reflect this clinical reality. At the same time, the bundled nature of the protocol prevents attribution of the observed improvement to any single component, including PRP itself, the local anesthetic, the procedure effect, or the specific anatomical target. The present study therefore evaluates a pragmatic package of care rather than an isolatable mechanistic intervention.

The magnitude and direction of change observed in this study are broadly consistent with prior literature suggesting that PRP may be associated with improvement in selected spinal pain conditions, including epidural and facet-based applications (15)(16)(17)(23)(24)(25).Direct comparison, however, is limited by substantial heterogeneity in patient selection, PRP preparation methods, injectate composition, treatment targets, and outcome definitions. Our results are best viewed as complementary to, rather than confirmatory of, that literature.

The temporal pattern of change in this cohort is highly clinically informative. Pain scores improved early, plateaued slightly at 1 month, and then showed their greatest gain between 1 and 3 months, while disability improvement became clearly significant later. This biphasic trajectory is compatible with the expected recovery course following an orthobiologic procedure, though it does not unequivocally establish a regenerative mechanism. The early reduction in pain at 1 week plausibly reflects a combination of local anesthetic effect, procedure-related contextual effects, and early symptomatic modulation rather than a direct, delayed biologic effect of PRP alone (26)(27).The relative plateau between 1 week and 1 month, followed by more substantial improvement from 1 to 3 months, is consistent with the delayed tissue-remodeling time course described in broader orthobiologic literature (28)(29). The more pronounced functional improvement between 1 and 3 months indicates that functional recovery required time beyond early analgesic change. Such a pattern possesses strong face validity in chronic low back pain, where reduced nociceptive input does not immediately translate into normalized activity, confidence in movement, or reduced disability (30)(31)(32)(33)(34)(35). The maintenance of improvement from 3 to 6 months suggests that early gains were durable over the study period.

An additional clinically relevant observation is the lag between improvement in pain scores and improvement in disability. ODI did not reach clear statistical significance until the 3-month time point, whereas NPS improved earlier. This dissociation likely reflects the multidimensional nature of disability in chronic low back pain, in which fear-avoidance, deconditioning, altered motor behavior, and central sensitization may persist even when pain intensity decreases (30)(31)(32)(33)(34)(35).

Accordingly, the present findings support the concept that a procedure such as Spinoplasty, if effective, would probably be best positioned within a broader multimodal management pathway rather than as a stand-alone solution. Future studies should evaluate whether structured rehabilitation after injection enhances functional recovery and sustains improvement.

The rationale for addressing multiple pain generators within a single session stems from the clinical recognition that chronic low back pain is rarely isolated to a single anatomical structure. This comprehensive approach is designed as a conceptual framework grounded in existing literature, rather than as direct evidence that each specific mechanism was observed within the present pilot study. By targeting various overlapping pain sources simultaneously, the “Spinoplasty” protocol aims to provide a more holistic intervention that reflects the complex, multi-layered pathology of the lumbar spine. The application of epidural injections within this protocol specifically addresses discogenic and radicular pain, which is frequently driven by chemical radiculitis. The proposed mechanism of action centers on a potent anti-inflammatory effect, where bioactive cytokines such as interleukin-1 receptor antagonist (IL-1RA) effectively counteract the pro-inflammatory mediators, such as tumor necrosis factor-alpha (TNF-α), typically released from damaged disc material. This biological modulation is supported by various meta-analyses, which indicate that this approach provides durable symptomatic relief that is often comparable, and in some cases superior, to traditional corticosteroid interventions corticosteroids (23). Simultaneously, the protocol incorporates intra-articular facet joint injections to manage pain arising from facet joint arthropathy and synovitis. Beyond simple analgesia, this component is intended to leverage chondroprotective effects and the active modulation of synovial inflammation, which collectively work to reduce localized pain and restore joint function. Clinical evidence from randomized controlled trials supports this target, demonstrating that regenerative injections can achieve superior long-term outcomes, specifically within the three-to-six-month window, when compared to the more transient effects of corticosteroid-based treatments (25). Finally, the inclusion of paraspinal trigger point injections provides a necessary intervention for the myofascial pain and muscular spasms that frequently accompany chronic spinal conditions. By promoting sarcomere repair and inhibiting the recruitment of pro-inflammatory cells, this target helps to resolve persistent muscular trigger points and their associated referred pain patterns. Research suggests that utilizing platelet-rich plasma for these muscular targets offers a more effective and significantly longer-lasting therapeutic result than conventional methods such as dry needling or the administration of local anesthetics alone (36).

The study has several strengths. It prospectively evaluates a clinically pragmatic, multi-target intervention that reflects the multifactorial nature of chronic low back pain, an area that is underrepresented in existing PRP literature. The use of standardized and validated outcome measures with serial follow-up

over 6 months provides valuable preliminary data on symptom trajectory and durability of response. Furthermore, the study demonstrates the feasibility and tolerability of delivering a comprehensive PRP-based protocol in a real-world clinical setting. These findings provide important effect-size estimates and inform the design of future research. However, observed improvements may reflect regression to the mean, placebo response, natural history of disease, or contextual effects associated with an invasive procedure, rather than a specific biological effect of PRP. Future studies should prioritize randomized controlled designs with appropriate comparator groups (e.g., corticosteroid injection or sham procedure), standardized PRP characterization, and intention-to-treat analysis. Incorporating responder analyses based on minimal clinically important differences and integrating structured rehabilitation protocols may further clarify the clinical role and optimize the effectiveness of this multi-target approach.

Limitations

This study has several important limitations that warrant careful consideration. First, patients were recruited consecutively from a single private interventional pain practice, which may introduce referral and selection bias and limit the external validity and generalizability of the findings. Second, the absence of statistically significant subgroup differences across variables such as sex, age, BMI, occupation, education level, and duration of pain should be interpreted with caution. The relatively small sample size (n = 29) limits statistical power and increases the risk of type II error; therefore, these analyses should be regarded as exploratory and primarily hypothesis-generating. In addition, the single-arm design, without randomization, blinding, or a control group, precludes causal inference and renders the findings susceptible to multiple sources of bias, including regression to the mean, natural disease progression, placebo effects, contextual influences, and unmeasured co-interventions. The bundled, multi-target nature of the intervention further complicates interpretation, as PRP was administered in combination with local anesthetic across multiple anatomical sites (epidural, facet joints, and paraspinal trigger points) within a single session. Consequently, it is not possible to isolate the specific contribution of PRP, the anesthetic agent, or individual injection targets to the observed outcomes. Methodologically, the use of a per-protocol analysis may have led to an overestimation of treatment effects, particularly in the context of participant attrition. Furthermore, partial reliance on telephone-based follow-up introduces the potential for reporting and recall bias. Finally, the retrospective trial registration and the single-center design further limit methodological rigor and reduce the generalizability of the results.

Conclusion

In this prospective pilot study, a bundled multi-target PRP injection protocol for chronic multifactorial low back pain was feasible, well tolerated, and associated with improvement in pain and function over 6 months. Because the study lacked a control group and used a non-isolatable intervention, the findings should be considered hypothesis-generating rather than confirmatory. Future research should prioritize randomized controlled designs, standardized PRP characterization, comparator arms, and integrated rehabilitation protocols to determine whether this approach offers true clinical benefit and for which patients.

Abbreviations

- **LBP** – Low Back Pain
- **PRP** – Platelet-Rich Plasma
- **NPS** – Numeric Pain Scale
- **ODI** – Oswestry Disability Index
- **SANE** – Single Assessment Numeric Evaluation
- **MRI** – Magnetic Resonance Imaging
- **NSAIDs** – Nonsteroidal Anti-Inflammatory Drugs
- **IRB** – Institutional Review Board
- **ACD-A** – Anticoagulant Citrate Dextrose Solution A
- **BMI** – Body Mass Index
- **SPSS** – Statistical Package for the Social Sciences
- **ANOVA** – Analysis of Variance
- **IL-1RA** – Interleukin-1 Receptor Antagonist
- **TNF-α** – Tumor Necrosis Factor Alpha
- **RCT** – Randomized Controlled Trial

Declarations

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Authors' contributions

MH contributed to writing the original draft, supervised the manuscript, edited the content, coordinated the research team, and led the manuscript preparation and final revision. **AK** participated in the statistical analysis and contributed to drafting the results section. **AN, MA, KA, and BA** contributed to the literature review, data collection and interpretation, and assisted in writing the original draft.

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Clinical trial number:

This study was registered retrospectively with ClinicalTrials.gov (Identifier: NCT07268885) on November 14, 2025.

Data Availability:

The dataset generated and/or analyzed during the current study are not publicly available due to patient privacy and institutional restrictions but are available from the corresponding author on resalable request. All data were de-identified prior to analysis.

Ethics approval :

Approval was secured from the Institutional Review Board (IRB) at the College of Medicine at Hebron University on September 9, 2024 (approval reference number: HC.MRC.March4222024). Written informed consent was obtained from all participants before enrollment.

Consent for publication:

Not applicable.

Competing interests:

The authors declare no competing interests.

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Figures

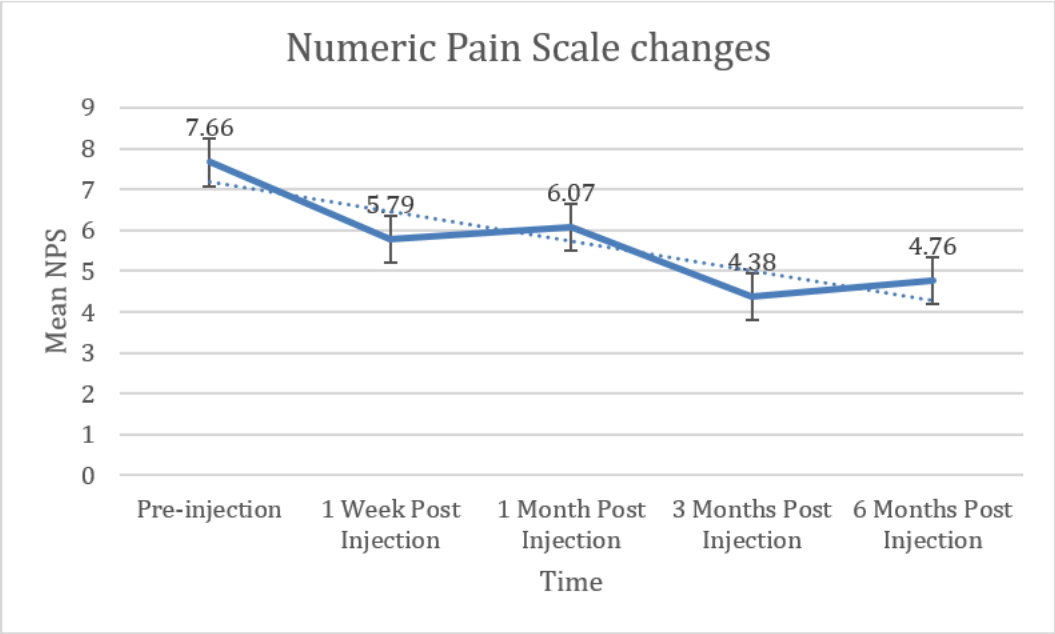


Figure 1

NPS trajectory over the 6-month follow-up period.

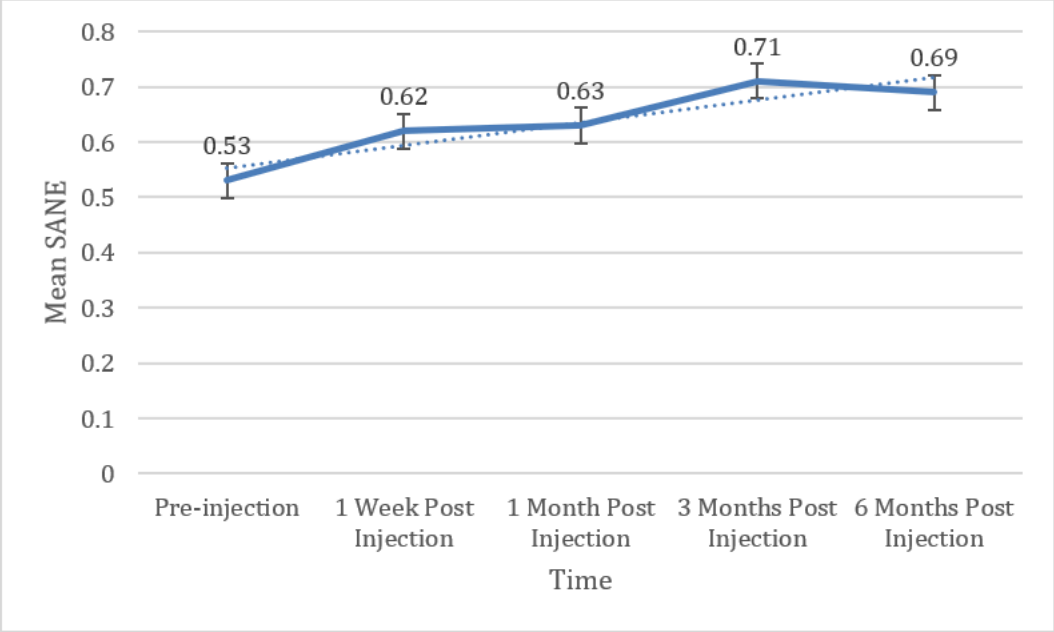


Figure 2

SANE trajectory over the 6-month follow-up period.

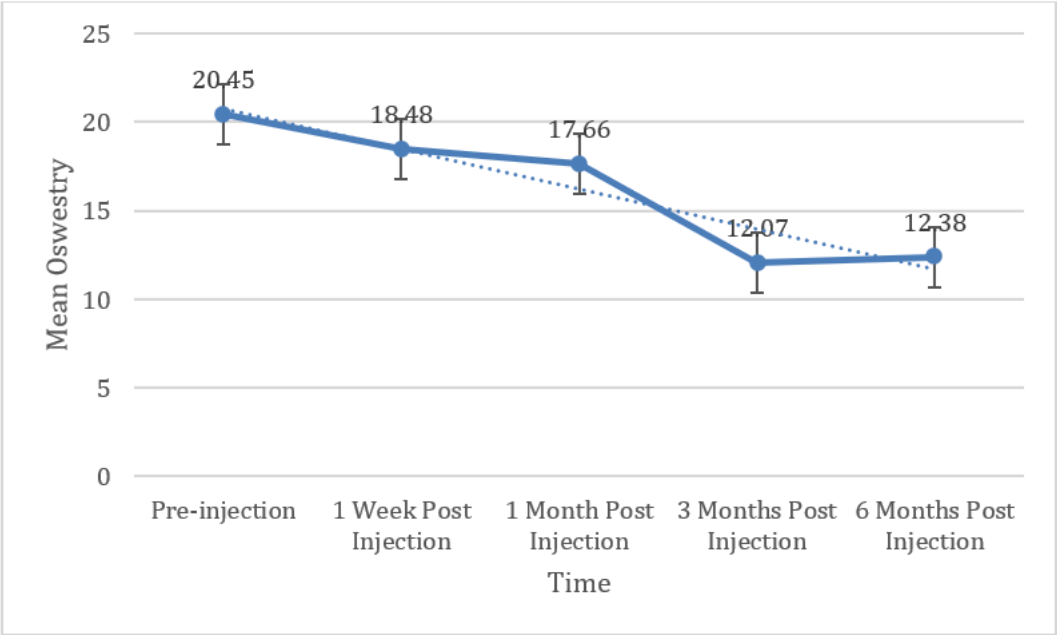


Figure 3

Oswestry trajectory over the 6-month follow-up period