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A Comparative Study of Platelet-Rich Plasma and Normal Saline Dressings in the Treatment of Chronic Wounds

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ABSTRACT

Chronic wounds pose a major challenge in clinical practice, often requiring advanced interventions. Platelet-rich plasma (PRP) dressings, by releasing growth factors, have emerged as a promising alternative to conventional approaches. **Objectives:** To compare the efficacy of PRP versus normal saline (NS) dressings in promoting wound healing. **Methods:** This randomized controlled trial was conducted at the Department of Surgery, Bahawal Victoria Hospital, Bahawalpur, from April to October 2024. A total of 156 patients with chronic wounds were randomized into PRP (n = 78) or NS (n = 78) groups. Baseline characteristics were recorded, and patients were followed for six weeks. Healing outcomes were analyzed using Chi-square and t-tests, with significance set at p≤0.05. **Results:** The PRP group achieved significantly higher healing (91.0%) compared to the NS group (66.7%) (p=0.000). Subgroup analysis revealed greater efficacy of PRP in older patients, female, immobile individuals, and those with long-standing wounds. PRP also showed superior results in diabetic (p=0.007) and pressure ulcers (p=0.004), though not in venous ulcers (p=0.477). **Conclusions:** PRP enhances chronic wound healing compared to saline dressings, with particular benefits in high-risk patient groups. It is a safe and effective therapeutic option.

INTRODUCTION

Chronic wounds remain a persistent challenge in clinical practice, not only delaying healing but also contributing to increased morbidity, disability, and healthcare costs. These wounds are typically defined as those that fail to progress through the orderly and timely phases of repair, and their persistence is often linked to factors such as local ischemia, infection, diabetes mellitus, or vascular insufficiency [1]. Because they rarely follow the expected biological cascade of hemostasis, inflammation, proliferation, and remodeling, they tend to remain in a chronic inflammatory state, further impairing tissue regeneration [2]. Traditional wound care strategies, including saline dressings, have been widely employed. While these methods help maintain wound moisture and prevent desiccation, their role in stimulating cellular and molecular repair is limited, often resulting in slow recovery and recurrent infections [3]. Hence, there has been increasing interest in therapeutic interventions that can actively promote wound healing by supplying essential biological cues. Among these, Platelet-Rich Plasma (PRP) has emerged as a promising modality. PRP is an autologous concentration of platelets suspended in plasma, enriched with growth factors such as platelet-derived growth factor (PDGF), vascular endothelial growth factor (VEGF), and transforming growth factor-beta (TGF-β), all of which are crucial mediators of wound repair [4, 5]. These molecules

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enhance angiogenesis, collagen synthesis, fibroblast migration, and epithelialization, while simultaneously modulating inflammation [6]. In this way, PRP is capable of creating a microenvironment more favorable for tissue regeneration compared to conventional dressings. Accumulating evidence from randomized controlled trials and meta-analyses has demonstrated that PRP accelerates wound closure, increases the rate of complete healing, and reduces complication rates when compared to saline dressings [7, 8]. Its effectiveness has been particularly well documented in diabetic foot ulcers, where PRP use resulted in faster granulation tissue formation, substantial reduction in wound size, and shorter overall treatment duration [9, 10]. Moreover, studies have reported reduced infection rates and improved patient quality of life without introducing additional adverse effects [11]. Importantly, although the preparation of PRP was initially considered complex, recent technical advances have simplified the procedure, making it inexpensive, reproducible, and feasible in routine clinical settings [12]. Given these advantages, PRP has become increasingly relevant in the search for effective strategies to manage chronic wounds. However, despite growing evidence in favor of PRP, there remains a need for context-specific data, particularly in resource-constrained healthcare systems where cost and feasibility strongly influence clinical decision-making.

This study aims to compare PRP dressings with normal saline dressings in patients with chronic wounds, with a primary focus on healing outcomes, to provide evidence that may guide future wound care practices.

METHODS

This randomized controlled trial (RCT registry No. NCT06849232) was conducted in the Department of Surgery at Bahawal Victoria Hospital, Bahawalpur, over six months from April 17, 2024, to October 16, 2024. Ethical approval was granted under letter number 2381/DME/QAMC/Bahawalpur, and written informed consent was obtained from all participants before enrollment. The trial was reported in accordance with the CONSORT 2010 guidelines. Patients were recruited using a non-probability consecutive sampling technique. The trial aimed to compare the effectiveness of platelet-rich plasma (PRP) dressings with normal saline (NS) dressings in the treatment of chronic wounds. A previous study by Orban *et al.* reported a healing rate of 86.1% with PRP dressings compared to 63.9% with NS dressings [13]. Using these proportions, with 90% power and a 5% level of significance, the sample size for each group was calculated using the formula for comparing two proportions: $n = [(Z_{1-}\alpha/_2 + Z_{1-}\beta)^2 \times (P_1(1 - P_1) + P_2(1 - P_2))] \div (P_1 - P_2)^2$. Where $Z_{1-a}/_2 = 1.96$ and $Z_{1-\beta} = 1.28$, $P_1 = 0.861$, and $P_2 = 0.639$. The calculated sample size was 78 patients per group, giving a total of 156 patients. This calculation followed the method described by Lwanga *et al.* [14]. Patients aged 18–60 years of either gender were included if they had a chronic wound persisting for at least six weeks and measuring at least 2 × 2 cm. Exclusion criteria were wounds of less than six weeks' duration, prior treatment with PRP dressings, known hypersensitivity to PRP, or burn injuries (confirmed by review of medical records). Baseline characteristics, including age, gender, HbA1C levels, mobility status (ambulatory or bed-bound), history of prolonged standing, wound duration, and wound type (diabetic, pressure, or venous), were documented. This information was obtained from patients' hospital records and files, including laboratory reports (for HbA1C), clinicians' notes, and direct history-taking at the time of enrollment. Eligible patients were recruited consecutively until the required sample size was reached, using a non-probability consecutive sampling approach. This method ensured that every patient meeting the inclusion criteria during the study period was considered for enrollment. After enrollment, participants were randomly allocated to either the PRP or NS dressing group using simple randomization (lottery method). To maintain allocation concealment, sequentially numbered, sealed, opaque envelopes were prepared by an independent researcher not involved in recruitment or assessment. Each envelope contained the group assignment generated by computer-assisted random numbers and was opened sequentially only after the patient was enrolled. No stratification or block randomization was applied, as baseline characteristics were comparable between groups. Because the PRP procedure was visible, neither the participants nor the treating surgeons could be blinded, making this an open-label trial. However, outcome assessment was performed by independent evaluators blinded to group allocation. These assessors were not involved in treatment administration and relied on standardized clinical parameters and serial wound photographs. PRP was prepared by the hematology department following a standardized two-step centrifugation technique. For each patient, 20 ml of venous blood was drawn under aseptic conditions into tubes containing acid-citrate-dextrose (ACD) as an anticoagulant. The first centrifugation ("soft spin") was performed at 1500 rpm for 10 minutes to separate red blood cells from plasma and the buffy coat. The upper plasma and buffy coat layers were carefully aspirated into a sterile tube and subjected to a second centrifugation ("hard spin") at 3000 rpm for 10 minutes. This yielded three layers: platelet-poor plasma (PPP) at the top, a middle buffy coat containing concentrated platelets, and red cells at the bottom. The upper PPP was discarded, and the platelet-

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rich fraction was collected. The final PRP contained a platelet concentration approximately 4–5 times higher than baseline counts, which was confirmed using hematology analyzers. The PRP was used immediately after preparation to preserve platelet activity. Patients in Group A received PRP dressings. Wounds were cleaned with NS, followed by injection of autologous PRP into the wound margins twice weekly, and then covered with sterile gauze. Patients in Group B received normal saline (NS) dressings, which represent the standard wound care practice in our hospital setting. As such, the NS group served as the positive control group, allowing comparison of PRP against an established conventional treatment rather than a placebo or no treatment. Patients were followed weekly for six weeks to monitor healing progress. At each visit, wound healing was evaluated by independent blinded assessors using three complementary approaches applied concurrently: (1) Visual inspection of the wound bed for epithelialization, granulation tissue formation, and reduction in exudate; (2) Serial standardized wound photographs taken under identical lighting and distance to allow week-to-week comparison; and (3) The Pressure Ulcer Scale for Healing (PUSH) version 3.0, developed by the National Pressure Ulcer Advisory Panel [15]. The PUSH tool quantifies three wound characteristics: surface area, exudate amount, and tissue type—each scored and summed to yield a total score from 0 to 17, where lower scores indicate better healing and a score of 0 represents complete epithelialization. The three assessments were interpreted together: when both clinical and photographic evaluation confirmed full epithelialization with absence of exudate or granulation tissue and the PUSH total score was 0, the wound was classified as healed; otherwise, it was considered not healed. These combined criteria were used to document weekly progress and determine healing status at six weeks. The primary outcome of the study was complete wound closure (PUSH = 0) by week six. Data were analyzed using SPSS version 22. Quantitative variables (age, HbA1C levels, wound duration) were expressed as mean ± standard deviation (SD). The normality of continuous variables (age, HbA1C, wound duration) was assessed using the Shapiro–Wilk test. As the data were normally distributed, results are expressed as mean ± SD. Within-group (pre- vs post-treatment) comparisons were made using McNemar's test for paired categorical variables (e.g., healed vs not healed at baseline and at week six) and the paired t-test for continuous variables such as PUSH total scores. Between-group comparisons were performed using the Chi-square test (or Fisher's exact test where applicable) for categorical variables and the independent t-test for continuous variables. In subgroup analyses, potential confounders, including diabetes status, glycemic control (HbA1C), mobility, and comorbidities, were adjusted for using multivariate logistic regression to assess the independent effect of PRP. The model's calibration was verified using the Hosmer–Lemeshow goodness-of-fit test. A p-value≤0.05 was considered statistically significant. The CONSORT flow diagram of participant enrollment, allocation, follow-up, and analysis was shown (Figure 1).

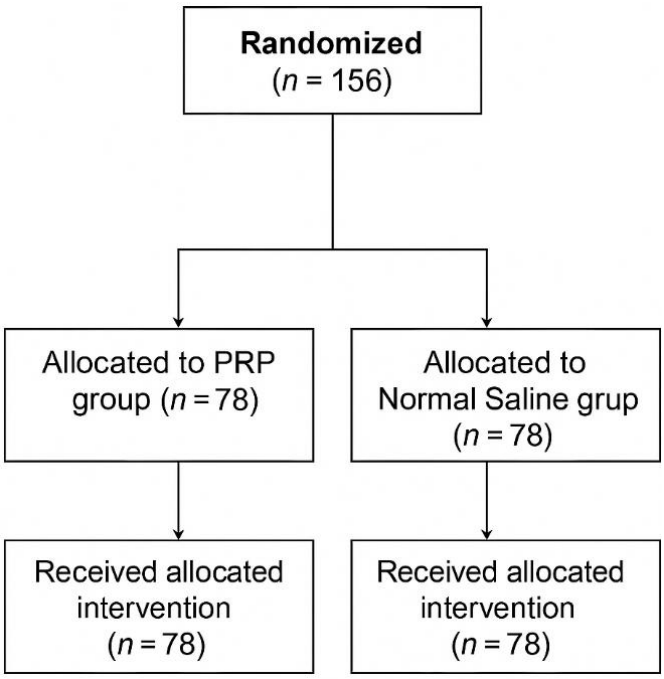

Figure 1: CONSORT Flow Diagram of Participant Enrollment, Allocation, Follow-Up, and Analysis

RESULTS

A total of 156 patients were included in this study. The mean age of participants was 38.67 ± 11.92 years, with an average HbA1C level of 6.92 ± 0.87%. The mean duration of the wound was 29.97 ± 12.93 weeks. The study compares the overall healing outcomes between the two groups of patients treated with PRP dressing and those treated with normal saline dressing. In the PRP group, 71 (91.0%) patients achieved complete wound healing, whereas 7 (9.0%) did not heal. In the normal saline group, 52 (66.7%) patients achieved healing, while 26 (33.3%) failed to heal. The difference between the two groups was statistically significant (p=0.000), demonstrating the superior efficacy of PRP dressing over saline dressing in promoting wound healing (Table 1).

Table 1: Comparison of Healing Outcomes Between PRP Dressing and Normal Saline Dressing

Group	Not Healed	Healed	p-Value
PRP Dressing	7 (9.0%)	71 (91.0%)	<0.001*
Normal Saline Dressing	26 (33.3%)	52 (66.7%)	

*=p<0.05 considered statistically significant.

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The study provides a subgroup analysis comparing healing outcomes between PRP and saline dressings. Among patients aged 18–40 years, PRP resulted in significantly higher healing rates (38 (86.4%)) compared to saline (26 (66.7%)) (p=0.033). Similarly, in the 41–60 years age group, PRP achieved 33 (97.1%) healing compared to 26 (66.7%) with saline (p=0.001). These findings indicate that PRP was effective in both younger and older patients, with a particularly notable benefit in older individuals. For wounds of shorter duration (6–12 weeks), PRP demonstrated 100% healing, while saline achieved 70.0% (p=0.041), suggesting that PRP may be more effective in newly formed wounds. For moderately chronic wounds (13–24 weeks), the difference between PRP (66.7%) and saline (84.6%) was not statistically significant (0.274). In long-duration wounds (25–36 weeks), PRP healed 90.5% compared to 69.2% with saline, although this difference did not reach statistical significance (p=0.077). However, for very long-duration wounds (37–51 weeks), PRP achieved 100% healing, whereas saline healed only 55.2% (p=0.000), demonstrating a clear benefit of PRP in managing chronic wounds of extended duration. In terms of gender, males showed high healing rates in both groups, with PRP achieving 33 (91.7%) compared to 29 (85.3%) in the saline group, a difference that was not statistically significant (p=0.402). In female, however, PRP was significantly more effective, achieving 38 (90.5%) healing versus 23 (52.3%) in the saline group (p = 0.000), suggesting that PRP may be particularly beneficial for female patients. Among ambulatory patients, PRP healed 40 (90.9%) compared to 24 (70.6%) with saline (p=0.020), showing a significant improvement in mobile individuals. Similarly, in bed-bound patients, PRP healed 31 (91.2%) compared to 28 (63.6%) in the saline group (p=0.005), highlighting the effectiveness of PRP even in immobile patients. Patients with a history of prolonged standing experienced significantly better outcomes with PRP (41 (91.1%)) than with saline (21 (55.3%)) (p=0.000). Among those without prolonged standing, the difference between PRP (30 (90.9%)) and saline (31 (77.5%)) was not statistically significant (p=0.124). In terms of wound types, PRP was particularly effective for diabetic wounds, achieving 22 (95.7%) healing compared to 18 (64.3%) with saline (p=0.007). Similarly, PRP outperformed saline in pressure ulcers, with 29 (90.6%) healing versus 15 (57.7%) (p=0.004). For venous ulcers, PRP healed 20 (87.0%), compared to 19 (79.2%) in the saline group, but this difference was not statistically significant (p=0.477) (Table 2).

Table 2: Comparison of Healing Outcomes by Different Variables Between PRP and Normal Saline Dressing

Variables	Subgroup	PRP Healed, n (%)	PRP Not Healed, n (%)	Saline Healed, n (%)	Saline Not Healed, n (%)	p-Value
Age	18–40 Years	38 (86.4%)	6 (13.6%)	26 (66.7%)	13 (33.3%)	0.033*
	41–60 Years	33 (97.1%)	1 (2.9%)	26 (66.7%)	13 (33.3%)	0.001*
Wound Duration	6–12 Weeks	12 (100%)	0 (0.0%)	7 (70.0%)	3 (30.0%)	0.041*
	13–24 Weeks	10 (66.7%)	5 (33.3%)	11 (84.6%)	2 (15.4%)	0.274
	25–36 Weeks	19 (90.5%)	2 (9.5%)	18 (69.2%)	8 (30.8%)	0.077
	37–51 Weeks	30 (100%)	0 (0.0%)	16 (55.2%)	13 (44.8%)	0.000*
Gender	Male	33 (91.7%)	3 (8.3%)	29 (85.3%)	5 (14.7%)	0.402
	Female	38 (90.5%)	4 (9.5%)	23 (52.3%)	21 (47.7%)	0.000*
Mobility Status	Ambulatory	40 (90.9%)	4 (9.1%)	24 (70.6%)	10 (29.4%)	0.020*
	Bed Bound	31 (91.2%)	3 (8.8%)	28 (63.6%)	16 (36.4%)	0.005*
Standing History	Yes	41 (91.1%)	4 (8.9%)	21 (55.3%)	17 (44.7%)	0.000*
	No	30 (90.9%)	3 (9.1%)	31 (77.5%)	9 (22.5%)	0.124
Type of Chronic Wound	Diabetic	22 (95.7%)	1 (4.3%)	18 (64.3%)	10 (35.7%)	0.007*
	Pressure	29 (90.6%)	3 (9.4%)	15 (57.7%)	11 (42.3%)	0.004*
	Venous	20 (87.0%)	3 (13.0%)	19 (79.2%)	5 (20.8%)	0.477

*=p<0.05 considered statistically significant.

After adjusting for potential confounding factors, including age, HbA1C, gender, mobility status, wound duration, and wound type, PRP remained a strong independent predictor of wound healing. Patients treated with PRP dressings were more than five times as likely to achieve complete healing compared to those treated with normal saline dressings (Adjusted OR=5.53, 95% CI: 2.11–14.49, p=0.000). In addition, female patients had significantly higher odds of healing compared to males (Adjusted OR=3.59, 95% CI: 1.32–9.77, p=0.012). Other variables, including age group, HbA1C level, mobility status, wound duration, and wound type, were not statistically significant independent predictors in the adjusted model. The overall model demonstrated good calibration (Hosmer–Lemeshow test p=0.962) and explained approximately 25% of the variance in wound healing outcomes (Nagelkerke R^2 = 0.253) (Table 3).

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Table 3: Multivariate Logistic Regression for Predictors of Wound Healing

Variable	Adjusted OR	95% CI	p-Value
Group (PRP vs Saline)	5.53	2.11–14.49	<0.001*
Gender (Female vs Male)	3.59	1.32–9.77	0.012*
Age (41–60 vs 18–40)	0.61	0.25–1.49	0.274
HbA1C (Continuous)	0.79	0.47–1.33	0.383
Mobility (Bed-bound vs Ambulatory)	1.75	0.70–4.34	0.228
Wound Duration (Ref = 37–51 Weeks)	—	—	0.829
6–12 Weeks	1.52	0.35–6.64	0.579
13–24 Weeks	0.75	0.22–2.55	0.644
25–36 Weeks	0.80	0.27–2.38	0.685
Wound Type (Ref = Venous)	—	—	0.466
Diabetic	0.84	0.26–2.74	0.774
Pressure	0.52	0.16–1.65	0.266

*=p<0.05 considered statistically significant.

Within-group analysis using McNemar's test demonstrated a statistically significant improvement in healing status from baseline to week six in both treatment groups (p<0.001 for each). All patients were unhealed at baseline, but by week six, 91.0% in the PRP group and 66.7% in the normal saline group achieved complete wound closure. This indicates that while both interventions facilitated significant within-group improvement, the magnitude of healing was markedly greater in the PRP group, reflecting its superior wound-healing potential compared with conventional saline dressings (Table 4).

Table 4: Within-Group Comparison of Healing Status (Pre- vs Post-Treatment) by McNemar's Test

Group		Healing Status at Week 6	Healing Status at Baseline	Improved, n (%)	McNemar's p-Value
PRP Dressing (n=78)	Not Healed	78 (100%)	7 (9.0%)	71 (91.0%)	<0.001 *
	Healed	0 (0%)	71 (91.0%)		
Normal Saline Dressing (n=78)	Not Healed	78 (100%)	26 (33.3%)	52 (66.7%)	<0.001 *
	Healed	0 (0%)	52 (66.7%)		

Test: McNemar's test for paired categorical data (pre- vs post-treatment). *=p<0.05 considered statistically significant.

DISCUSSIONS

This study demonstrated the superiority of Platelet-Rich Plasma (PRP) dressing over Normal Saline (NS) dressing in promoting wound healing, as evidenced by significantly higher healing rates in the PRP group. These findings align with the broader literature on PRP in wound management, which has shown promising outcomes in diverse clinical settings. In our study, 71 (91.0%) patients in the PRP group achieved wound healing compared to 52 (66.7%) in the NS group (p=0.000). These results are consistent with the study by Orban *et al.*, which reported an 86.1% healing rate with PRP compared to 63.9% in the conventional dressing group, highlighting PRP's effectiveness in accelerating wound closure [13]. Subgroup analyses further supported PRP's benefits across different patient profiles. In younger patients (18–40 years), healing was achieved in 86.4% with PRP versus 66.7% with NS (p=0.033). Among older patients (41–60 years), PRP demonstrated an even greater advantage, with 97.1% healing compared to 66.7% in the NS group (p=0.001), consistent with Fibrini *et al.* [16]. PRP also showed superior outcomes in long-standing wounds (37–51 weeks), achieving 100% healing compared to 55.2% with NS (p=0.000), underscoring its potential in managing difficult chronic wounds, as also supported by Orban *et al.* [13]. Gender-specific analysis revealed that PRP was particularly effective in female, with 90.5% healing compared to 52.3% with NS (p=0.000). In males, however, healing rates were high in both groups with no significant difference. These findings mirror El-Mabood *et al.* [17], who reported greater improvements in female patients. Patients with a history of prolonged standing also benefited significantly from PRP, with 91.1% healing versus 55.3% with NS (p=0.000), in line with Syafira *et al.* [18]. When analyzed by wound type, PRP was especially effective for diabetic wounds (95.7% vs. 64.3%, p=0.007) and pressure ulcers (90.6% vs. 57.7%, p=0.004), echoing the findings of Elsaid *et al.* and Peng *et al.* respectively [19, 20]. However, for venous ulcers, healing rates did not differ significantly (87.0% vs. 79.2%, p = 0.477), consistent with Li *et al.* who noted variable outcomes in this subgroup [2]. Importantly, the results of our multivariate logistic regression analysis confirmed that PRP is an independent predictor of wound healing, even after adjusting for age, HbA1C, gender, mobility, wound duration, and wound type. Patients treated with PRP had 5.5 times higher odds of healing compared to NS (Adjusted OR = 5.53, 95% CI: 2.11–14.49, p=0.000). Female gender also emerged as an independent predictor of higher healing rates (Adjusted OR = 3.59, 95% CI: 1.32–9.77, p=0.012), while other variables were not statistically significant. These findings reinforce that PRP's superiority is not simply due to imbalances in patient characteristics but represents a genuine therapeutic effect. No adverse effects were observed in patients treated with PRP, supporting its safety profile. This is consistent with meta-analyses by Li *et al.* and Suthar *et al.* which concluded that PRP is safe and does not increase the risk of infection or complications [2, 21]. Finally, it should be acknowledged that our study recorded healing status at six weeks but did not capture the exact week of wound closure. As a result, time-to-complete healing could not be analyzed. Future trials incorporating detailed weekly healing data and survival analyses are warranted to provide stronger evidence of PRP's superiority in accelerating wound closure.

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CONCLUSIONS

This randomized controlled trial demonstrated that platelet-rich plasma (PRP) dressings significantly improved healing outcomes in chronic wounds compared with normal saline dressings. At six weeks, 91.0% of patients in the PRP group achieved complete wound healing compared to 66.7% in the saline group (p=0.000). Subgroup analyses showed PRP to be particularly effective in older patients, females, bed-bound individuals, and those with long-standing wounds. PRP also enhanced healing in diabetic and pressure ulcers, though no significant advantage was observed in venous ulcers. Importantly, multivariate analysis confirmed that PRP was an independent predictor of wound healing, even after adjusting for potential confounders.

Authors Contribution

Conceptualization: SH
Methodology: SH, AS
Formal analysis: SH
Writing review and editing: AS

All authors have read and agreed to the published version of the manuscript

Conflicts of Interest

All the authors declare no conflict of interest.

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