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Platelet Rich Plasma Dressing Versus Normal Saline Dressing in the Management of Chronic Diabetic Wounds

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ABSTRACT

Platelet-rich plasma (PRP) has emerged as a promising modality in wound healing due to its concentration of platelets and growth factors that stimulate tissue repair, angiogenesis, and epithelialization. **Objectives:** To compare the efficacy of PRP dressings with normal saline dressings in the management of chronic diabetic ulcers. **Methods:** This randomized controlled trial was conducted at the Department of Surgery, Gulab Devi Hospital, Lahore, from January 2025 to June 2025. After ethical approval, 156 patients with chronic diabetic wounds were recruited using consecutive sampling and randomly allocated into PRP and NS dressing groups (1:1). Interventions were administered over six weeks. Baseline and weekly wound area and healing status were assessed. Data were analyzed using SPSS version 26. A confidence level of 95% was used for all statistical analyses. Results were considered statistically significant at a p-value ≤0.05. **Results:** A total of 156 patients were enrolled, with a mean age of 39.05 ± 9.75 years and mean BMI of 25.85 ± 2.30 kg/m^2. Males comprised 63.5% of the participants, and 53.2% were aged 41–60 years. Complete healing was achieved in 92.3% of PRP patients compared to 61.5% in the NS group (p<0.001). PRP significantly reduced healing time (3.62 ± 1.25 vs. 4.85 ± 1.27 weeks; p<0.001) and post-treatment infections (7.7% vs. 23.1%; p=0.008), with no amputations in the PRP group. **Conclusions:** PRP dressing offers a more effective and safer alternative to conventional care in managing chronic diabetic wounds, promoting timely healing and supporting its inclusion in clinical wound care strategies.

INTRODUCTION

Chronic diabetic wounds, particularly diabetic foot ulcers, are an important and growing global health problem, with especially high prevalence in countries like Pakistan [1]. Globally, approximately 15% of diabetic individuals will develop foot ulcers in their life, and up to 25% of these cases may progress to lower limb amputation if not effectively managed [2]. The prevalence of diabetic foot ulcers in Pakistan is 12.16%, rising to 19.54% in studies from 2011–2022 [3]. In Punjab, the prevalence is 16.83%, higher in urban (17.96%) than rural (13.91%) areas, and peaks at 66.67% in individuals aged 75 and above [4]. These wounds are featured by impaired healing due to presence of neuropathy, ischemia, and immune dysfunction, leading to persistent inflammation and deficient tissue regeneration [5]. Standard wound care in DFUs generally comprises debridement, infection control, pressure offloading, and moisture-retaining dressings, with normal saline (NS) being one of the most commonly used solutions. Although NS is safe, affordable, and facilitates autolytic debridement, it lacks intrinsic biological activity and does not directly contribute to the wound healing cascade. This limitation often results in delayed granulation and epithelialization, particularly in patients with extensive or ischemic wounds. In recent years, autologous platelet-rich

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plasma (PRP) has originated as an adjunctive treatment in wound management. PRP is a plasma fraction enriched with platelets and their associated growth factors [6, 7]. These molecules play an important role in wound healing by promoting angiogenesis, fibroblast migration, matrix remodeling, and epithelial regeneration. In addition, PRP may exert antimicrobial and anti-inflammatory effects, which further enhance its therapeutic utility [8, 9]. Multiple randomized controlled trials and systematic reviews have reported favorable outcomes with PRP application in chronic wound settings. Healing rates, time to epithelialization, and wound contraction have all shown statistically significant improvements with PRP compared to NS dressing. For instance, Elsaid *et al.* demonstrated a mean healing time of 10.9 ± 3.4 weeks in the PRP group versus 13.5 ± 3.4 weeks in the saline group (p=0.01), and Narayanan *et al.* noted that the PRP group demonstrated an average healing duration of 3.17 weeks versus 4.56 weeks in the NS group ($p < 0.001$) [10, 11]. A study by Afzal Ali *et al.* documented a decrease in wound area and faster granulation tissue formation in PRP-treated ulcers compared to saline dressings [12]. Furthermore, a meta-analysis by Li *et al.* noted that PRP was linked with higher odds of complete healing at 8 and 12 weeks, without increasing the incidence of adverse events [13]. Pakistan carries one of the highest global burdens of diabetes, with foot ulcers. Patients frequently present with poorly controlled disease, recurrent infections, and high amputation risk, while access to advanced wound care remains limited [14, 15].

Although PRP has shown favorable outcomes in international studies, evidence from South Asia is scarce and not readily generalizable due to differences in healthcare systems and patient profiles. This trial was therefore designed to provide region-specific data to support cost-effective management of chronic diabetic wounds. This research seeks to contribute robust evidence to support optimized and individualized wound care strategies for diabetic patients.This study aims to compare the wound healing efficacy of PRP dressing versus NS dressing in patients with chronic diabetic wounds and to assess time to complete healing and evaluate complication rates(infection, amputation, failed healing).

METHODS

A randomized controlled trial (ID: NCT06867328) was carried out at the Department of Surgery, Gulab Devi Hospital, Lahore, from January 2025 to June 2025. Ethical approval was taken from the Institutional Ethical Review Board of Gulab Devi Hospital, Lahore (Ref. No. AAMC/IRB/EA/18/2025). A non-probability consecutive sampling technique was used to enroll eligible patients presenting with chronic diabetic wounds. The sample size was measured by assuming a 5% level of significance, 90% power, an anticipated wound healing rate of 86.11% in the PRP group and 63.89% in the normal saline group [16]. A total of 170 patients were initially recruited. Fourteen patients did not complete the study due to withdrawal of consent or missed follow-up visits and were excluded from analysis. Thus, 156 patients who completed all planned follow-up visits were included in the final analysis. Patients aged 18 to 60 years of either gender with DM and a chronic diabetic foot ulcer of at least 6 weeks' duration, measuring 2–10 cm^2 post-debridement and classified as Wagner grade II to IV, were included. Patients with ulcer-site infection or gangrene, prior PRP or grafting on the same ulcer, uncontrolled comorbidities (heart failure, dialysis-dependent renal disease, hepatic dysfunction), recent immunosuppressive use, bleeding disorders, tendon or bone involvement, malignancy, or autoimmune disease were excluded. After obtaining informed consent, all participants were assigned to one of two groups using a computer-generated simple randomization technique: the PRP dressing group or the normal saline (NS) dressing group. Allocation concealment was ensured using sealed, opaque envelopes opened at the time of intervention. Baseline demographic and clinical variables, including age, gender, duration of diabetes, HbA1c, BMI, ulcer type, co-morbidities, wound duration, wound area, and Wagner grade, were documented before initiating treatment. In the PRP group, autologous PRP was prepared using a standardized two-step centrifugation technique to reduce variability observed in previous studies. Venous blood (20 mL) was drawn from each patient into tubes containing acid citrate dextrose anticoagulant in a 9:1 ratio. The first centrifugation was performed at 1,500 rpm for 10 minutes to separate the plasma from red cells. The supernatant plasma was then subjected to a second centrifugation at 3,500 rpm for 15 minutes to concentrate the platelets. The upper platelet-poor fraction was discarded, and the lower one-third containing the platelet-rich plasma was collected. The obtained PRP was applied without the use of exogenous activators: approximately half was infiltrated around the wound margins, while the remainder was spread evenly over the wound bed, followed by sterile gauze placement. This double-spin protocol was consistently applied for all PRP-treated patients to ensure standardization and reproducibility. The PRP dressing was repeated twice weekly for a total of six weeks, provided there was no sign of infection or adverse reaction. In the NS group, sterile gauze soaked in normal saline was applied to the wound, ensuring full coverage of the wound bed. Dressings were changed daily or as needed based on wound exudate. In both groups, wounds were cleaned and debrided under aseptic technique before dressing

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application. All patients received standard offloading measures appropriate to their ulcer location and regular monitoring of glycemic control as part of routine care. Wound healing progress was monitored weekly for six consecutive weeks. At each follow-up visit, the wound was cleaned, assessed, and the area was measured using a sterile disposable ruler. Healing status was documented as either "Healed" (formation of pinkish granulation tissue completely over the wound, declared by the consultant surgeon through visual inspection) or "Not Healed". The duration required to achieve complete healing and complications, including signs of local infection (increased discharge, redness, foul odor), need for amputation, and failure to heal (no significant reduction in wound area by week six), were also monitored. Statistical analysis was conducted using SPSS 26.0. Continuous variables were expressed as mean and standard deviation and compared using an independent samples t-test, while categorical variables were summarized as frequencies and percentages and analyzed by chi-square test. Effect sizes were reported as mean differences for continuous data and odds ratios (OR) with 95% confidence intervals (CI) for categorical outcomes. Healing status and wound area over six weeks were analyzed using repeated measures ANOVA and chi-square tests. A p-value ≤0.05 was considered significant (Figure 1).

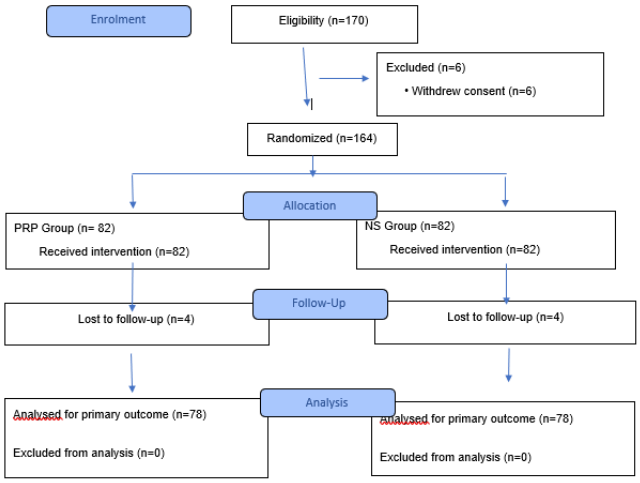

Figure 1: CONSORT-Style Flow Diagram

RESULTS

In this study, 156 patients were included with an average age of 38.55 ± 10.74 years in the PRP group and 39.56 ± 8.60 years in the NS group (p=0.517). A greater proportion of participants in the NS group were aged 18–40 years (65.4% vs. 46.2%, p = 0.016), whereas the PRP group had more individuals aged 41–60 years (53.8% vs. 34.6%). The average duration of diabetes was lower in the PRP group (8.27 ± 2.06 years) compared to the NS group (9.50±2.65 years; p=0.001), and the PRP group also demonstrated better glycemic control with a lower mean HbA1c (7.84 ± 0.41 vs. 8.03 ± 0.45; p=0.006). Wound duration was significantly shorter in the PRP group (7.44 ± 1.59 weeks) compared to the NS group (8.33 ± 1.76 weeks; p=0.001) (Table 1).

Table 1: Comparison of Baseline Characteristics Between PRP and Normal Saline Groups

Variables	Subgroup	PRP Group	NS Group	Test Statistic (χ^2 / t)	Effect Size (OR / Mean Diff. [95% CI])	p-value
Age Group (years)	18–40	36 (46.2%)	51 (65.4%)	χ^2=5.847	OR=0.454 [0.238–0.865]	0.016
	41–60	42 (53.8%)	27 (34.6%)			
Gender	Male	48 (61.5%)	51 (65.4%)	χ^2=0.249	OR=0.847 [0.441–1.627]	0.618
	Female	30 (38.5%)	27 (34.6%)			
Type of Ulcer	Neuropathic	54 (69.2%)	57 (73.1%)	χ^2=0.281	OR=0.829 [0.414–1.659]	0.596
	Non-neuropathic	24 (30.8%)	21 (26.9%)			
Hypertension	Yes	33 (42.3%)	27 (34.6%)	χ^2=0.975	OR=1.385 [0.725–2.647]	0.323
Ischemic Heart Disease	Yes	24 (30.8%)	15 (19.2%)	χ^2=2.769	OR=1.867 [0.890–3.914]	0.096
Smoking	Yes	21 (26.9%)	26 (33.3%)	χ^2=0.761	OR=0.737 [0.371–1.465]	0.383
Wagner Grade	II	45 (57.7%)	48 (61.5%)	χ^2= 1.430	–	0.489
	III	21 (26.9%)	15 (19.2%)			
	IV	12 (15.4%)	15 (19.2%)			
Age (years)	–	38.55 ± 10.74	39.56 ± 8.60	t = -0.650	-1.013 [-4.090–2.064]	0.517
Duration of Diabetes (years)	–	8.27 ± 2.06	9.50 ± 2.65	t = -3.236	-1.231 [-1.982–-0.479]	0.001
BMI (kg/m^2)	–	25.89 ± 2.16	25.81 ± 2.43	t = 0.192	0.071 [-0.656–0.797]	0.848
HbA1c (%)	–	7.84 ± 0.41	8.03 ± 0.45	t = -2.801	-0.191 [-0.325–-0.056]	0.006
Wound Duration (weeks)	–	7.44 ± 1.59	8.33 ± 1.76	t = -3.337	-0.897 [-1.429–-0.366]	0.001
Wound Area (cm^2)	–	6.67 ± 2.52	7.09 ± 2.57	t = -1.038	-0.423 [-1.228–0.382]	0.301

Chi-square test was used for dichotomous variables, and the Independent Samples t-test was applied for continuous variables. A p-value <0.05 was considered statistically significant

Repeated measures ANOVA showed a significant effect of time on wound area reduction (F4.003, 616.529 = 364.275, p<0.001,

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η^2=0.703), indicating progressive healing in both groups. A significant group effect (F1,1541=14.734, p<0.001, η^2=0.087) and a group × time interaction (F4.003,616.529=6.621, p<0.001, η^2=0.041) confirmed that PRP-treated wounds healed faster than NS-treated wounds (Table 2).

Table 2: Results of Repeated Measures ANOVA for Wound Area Over Six Weeks

Effects	DF	F	p-value	Partial η^2	Interpretation
Time (Week effect)	4.003, 616.529	364.275	<0.001	0.703	Wound area decreased significantly across weeks
Group (PRP vs NS)	1, 154	14.734	<0.001	0.087	PRP wounds were consistently smaller than NS wounds
Time × Group	4.003, 616.529	6.621	<0.001	0.041	PRP showed a faster healing trajectory compared with NS

The PRP group consistently demonstrated higher healing rates across all weeks, with statistically significant differences emerging from Week 3 onward. In Week 1, healing was observed in 7.7% (PRP) versus 3.8% (NS) (p=0.303). Week 2 showed a non-significant trend favoring PRP (23.1% vs. 11.5%, p=0.057). From Week 3, healing was higher in PRP group: 46.2% vs. 23.1% (p=0.002), 69.2% vs. 38.5% in Week 4 (p<0.001), 84.6% vs. 53.8% in Week 5 (p<0.001), and 92.3% vs. 61.5% in Week 6 (p<0.001), confirming superior efficacy of PRP (Figure 2).

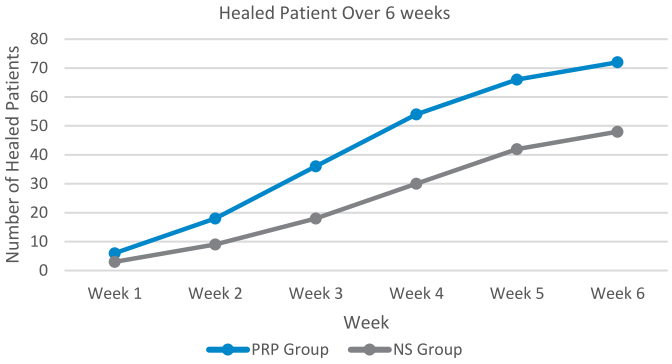

Figure 2: Comparison of Healing Status (Healed/Not Healed) Between PRP and NS Groups Over 6 Weeks

At final follow-up, complete healing was achieved in 92.3% of patients in the PRP group versus 61.5% in the NS group (χ^2=20.800, OR=7.500 [95% CI: 2.902–19.384], p<0.001). The average time to wound healing was shorter in the PRP group at 3.62 ±1.25 weeks compared to 4.85 ±1.27 weeks in the NS group (t=–6.099, MD=–1.231 [95% CI: –1.629 to –0.832], p<0.001) (Table 3).

Table 3: Comparison of Final Healing Status and Duration to Wound Healing Between PRP and NS Groups

Variables	PRP Group	NS Group	χ^2 / t-value	Effect Size [95% CI]	p-value
Complete healing, n (%)(yes)	72 (92.3%)	48 (61.5%)	χ^2= 20.800	OR=7.500 [2.902 –19.384]	<0.001
Mean healing duration (weeks)	3.62 ± 1.25	4.85 ± 1.27	t= -6.099	MD =-1.231 [-1.629 to -0.832]	<0.001

Chi-square test was used for dichotomous variables, and the Independent Samples t-test was applied for continuous variables. A p-value < 0.05 was considered statistically significant

Post-treatment complications were lower in the PRP group than in the NS group. Infection occurred in 6 (7.7%) PRP-treated patients versus 18 (23.1%) in the NS group (p=0.008). Amputations were reported in 6 (7.7%) patients from the NS group, with no cases observed in the PRP group (p=0.012). Failed healing was markedly more prevalent in the NS group (30; 38.5%) than in the PRP group (6; 7.7%) (p<0.001) (Figure 3).

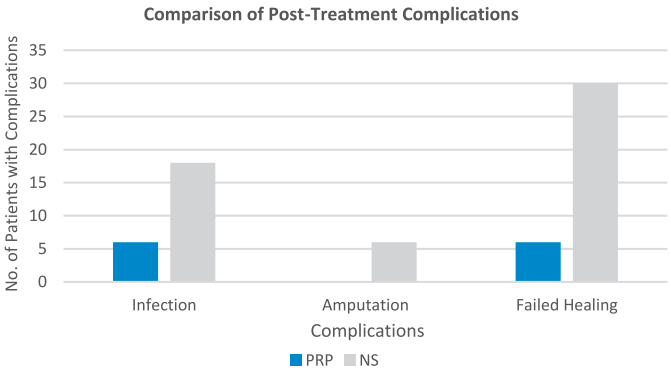

Figure 3: Comparison of Post-Treatment Complications Between PRP and Normal Saline Groups

DISCUSSION

This study of 156 patients demonstrates a significantly higher rate and earlier onset of wound healing, reduced complications, and shorter healing time associated with PRP dressing, reinforcing its therapeutic superiority. Age distribution differed significantly (p=0.016), with more younger patients in the NS group, aligning with previous studies [10]. Gender distribution was balanced (p=0.618), consistent with earlier reports [17]. In terms of wound progression, PRP demonstrated a consistent and significantly greater reduction in wound area beginning from Week 4 onwards, culminating in a mean wound size of 0.85 ± 0.67 cm^2 at Week 6 compared to 1.65 ± 0.88 cm^2 in the NS group. This progressive decline in wound dimensions parallels findings from previous studies [12, 18, 19]. Complete healing by Week 6 was observed in 92.3% of PRP-treated participants versus 61.5% in the NS group, with an odds ratio of 7.5 (p<0.001). These outcomes align with meta-analytical data reporting higher odds of complete healing with PRP [13, 20]. The mean healing duration was significantly shorter in the PRP group (3.62 ± 1.25 weeks) compared to 4.85 ± 1.27 weeks in the NS group [11, 21]. Post-treatment complications were markedly lower in the PRP group. Infections occurred in only 7.7% of PRP patients versus 23.1% in the NS group (p=0.008), with zero amputations in PRP versus 7.7% in NS (p=0.012). Failed healing was significantly more frequent in NS (38.5%) than PRP (7.7%), indicating a protective role of PRP not only in

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promoting healing but also in preventing adverse outcomes [12, 20]. The trajectory of weekly healing rate and cumulative healed cases throughout the 6-week follow-up further supports the superior regenerative effect of PRP. Healing rates were significantly higher from Week 3 onwards, with statistically significant odds ratios ranging from 2.857 to 7.500 [19]. This study's strengths include its randomized controlled design, adequate sample size, and weekly follow-up assessments, enabling precise evaluation of wound healing progression.

Limitations include the single-center setting, restricting generalizability, and a lack of blinding, which may introduce observer bias. Additionally, histological assessment of wound tissue and long-term follow-up were not performed. Future studies should incorporate multicenter designs, larger populations, and explore cellular mechanisms of PRP. Comparative evaluations with other advanced dressings and extended outcome tracking would further substantiate the clinical utility and cost-effectiveness of PRP therapy.

CONCLUSIONS

In conclusion, platelet-rich plasma (PRP) dressings were more effective than normal saline (NS) dressings in the management of chronic diabetic wounds. PRP accelerated wound area reduction, shortened healing time, and lowered complication rates compared with NS. These findings support the clinical utility of PRP as a superior dressing method for chronic diabetic ulcers and highlight its potential integration into standard wound care protocols.

Authors' Contribution

Conceptualization: MQ, KA, MM, ZH
Methodology: MQ, KA, MM, ZH, MS
Formal analysis: MQ, KA, MM, ZH, MS, MIJ, AA
Writing and drafting: MQ, KA, MM, ZH, MS, MIJ, AA
Review and editing: MQ, KA, MM, ZH, MS, MIJ, AA

All authors approved the final manuscript and take responsibility for the integrity of the work.

Conflicts of Interest

All the authors declare no conflict of interest.

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